USING SPEECH-GENERATING DEVICES AT HOME

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Att använda samtalshjälpmedel i hemmet:
En studie av barn med autismspektrumstörning i olika stadier av kommunikationsutvecklingen

Sammanfattning

Huvudsyftet med denna studie var att undersöka om och hur kommunikationen påverkades då barn med autismspektrumstörning fick tillgång till samtalshjälpmedel i olika aktiviteter i hemmet. Fyra barn i åldrarna mellan fem och sju år, på olika nivå i kommunikationsutvecklingen, deltog i studien. En familjeorienterad gemensam problemlösningsmodell användes som utgångspunkt för interventionen och i beslutsprocessen vid val av aktiviteter och utformning av hjälpmedelsapplikationer. Barnen och deras föräldrar videofilmades före och under det att samtalshjälpmedlen användes. Videoupptagningarna kodades inom fem dimensioner: roll i turtagning, kommunikativ form, funktion, effektivitet samt engagemang i aktiviteten. En analys av samtalsämnen utfördes också och valda videoavsnitt transkriberades för att illustrera interaktionsmönster. Aktivitetsbaserad kommunikationsanalys användes som metod för att jämföra kommunikation i de olika aktiviteterna före och under intervention. Intervju med Vineland Adpative Behavior Scales (VABS) utfördes för samtliga barn innan och efter undersökningsperioden. I den första delstudien jämfördes de fyra barnens resultat med avseende på *kommunikation och kommunikationsutveckling*. Den andra studien fokuserade *aktivitetens inverkan* på kommunikationen. Förändringar i användning av *samtalsämnen och interaktion* mellan barnet och föräldern undersöktes i den tredje studien. Den fjärde studien utgjordes av en fallstudie där resultaten från interventionen i *hemmet* jämfördes med användning av samtalshjälpmedlet i en aktivitet i *skolan* (samling).

Resultaten visade att effektiviteten i kommunikationen ökade i alla aktiviteter för samtliga barn, oavsett kommunikativ nivå. Intervjuerna med VABS visade att barnen utvecklats inom normeringen för barn med autism. Vad gäller de tre aktiviteter som studerades i hemmiljön (måltid, sagoläsning och 'berätta vad som hänt på dagis'), noterades en mer markant ökning av kommunikationseffektivitet då syftet med aktiviteten var kommunikativt snarare än praktiskt. Måltidsaktiviteten, den aktivitet som oftast använts i forskning men då i en klinisk eller pedagogisk miljö, förefaller inte vara lika lämplig att använda i intervention i hemmet. Instruktionen till föräldrarna att också använda samtalshjälpmedlet i sin kommunikation till barnet medförde en positiv förändring: de kom fysiskt närmare sina barn och de olika momenten och målen i aktiviteterna blev mer synkroniserade. Bilderna och vokabulären i samtalshjälpmedlet föreföll utgöra en gemensam och konkret referensram under kommunikationen. Samtalsanalysen visade att antalet irrelevanta samtalsbidrag minskade parallellt med att längden på samtalsämnena, dvs. antalet bidrag per samtalsämnessegment, ökade i flertalet av de inspelade situationerna. Jämförelsen av användning av samtalshjälpmedlet i hemmet och i skolan visade att egenskaper i aktiviteten tycktes ha större betydelse för hur samtalshjälpmedlet användes, snarare än miljön. Under samling i skolan och sagoläsning i hemmet intog den vuxne en styrande roll. Kommunikationen i dessa aktiviteter kom att likna varandra mer än de två aktiviteterna i hemmet. Detta pekar mot följande kliniska implikationer för användning av samtalshjälpmedel i hemmet: samtalshjälpmedel kan öka interaktion och kommunikation mellan barn med autismspektrumstörning på olika nivå och deras föräldrar, men det verkar också finnas behov av att ge föräldrarna mer kunskap om interaktion och kommunikationsstrategier.

Nyckelord: autismspektrumstörning, alternativ och kompletterande kommunikation (AKK), samtalshjälpmedel, kommunikationsutveckling, kommunikation, interaktion, samtalsämnen, hemmet, aktivitet, miljö

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The appendices are found after the four studies, at the end of the thesis.

underlying unity, namely a manifestation of the symptom triad found by Wing and Gould (1979): impairments of (1) social interaction, (2) communication, and (3) fantasy, together with a narrow repetitive range of activities and social interests (Wing, 2005). Exactly which disorders should be included in the spectrum and how broadly the spectrum extends are controversial, but the major autism spectrum disorders are autism, childhood disintegrative disorder, Asperger syndrome and atypical autism/pervasive developmental disorders – not otherwise specified (Lord & Risi, 2000). Epidemiological surveys of autism have been carried out in several countries but methodological differences make comparisons difficult (Fombonne, 2005). Fombonne suggests 35/10,000 and 60/10,000 as two working prevalence rates for the combination of all autism spectrum disorders. Autism has been found to be associated with mental retardation in 70% of cases and is over-represented in males, with a male/female ratio of 4.3:1 (Fombonne, 2005). There is general agreement that autism is a developmental disorder and that autism and associated disorders represent the behavioural manifestations of underlying dysfunctions of the central nervous system (Volkmar & Klin, 2005).

Difficulties with language and communication in ASD

Major advances have been made over the two past decades in understanding the social-communication difficulties of children with ASD, resulting in greater emphasis on early social-communication features in the diagnostic criteria (Wetherby, 2006). The second of the three main criteria for autism in both diagnostic systems (DSM-IV and ICD-10) specifically concern communication, while the first concerns impairment in social interaction, which involves body communication to a great extent (table 1). Most parents of children with autism first begin to be concerned that something is not quite right in their child's development because of early delays or regressions in the development of speech (Short & Schopler, 1988). Problems with communication, in terms of both understanding and expression, are often said to be one of the main causes of the severe behaviour problems that are common among persons with severe autism and mental retardation (Carr et al., 1997). The lack of meaningful, spontaneous speech by age five has been associated with poor adult outcomes (Billstedt, 2007; Billstedt, Gillberg, & Gillberg, 2005; Howlin, Goode, Hutton, & Rutter, 2004; Shea & Mesibov, 2005). Certainly, communication and communication problems are at the heart of what ASD is all about.

Although all persons diagnosed with autism have problems with communication, their type and degree vary a lot and the work of identifying different subgroups has just begun. It has been estimated that between one-third (Bryson, 1996) and one-half (Bryson, Clark, & Smith, 1988) of children and adults with autism have no speech. However, recent research results indicate that the proportion of non-speaking children with ASD is much smaller, approximately 14% to 20%, among those who received very early intervention (Lord, Risi, & Pickles, 2004). Two phenotypes of speaking children with ASD were identified by Tager-Flusberg and Joseph (2003): children with normal linguistic abilities (phonological skills, vocabulary, syntax, and morphology) and children with impaired language that is similar to the phenotype found in specific language impairment. Another potential subgroup may experience verbal dyspraxia or dyspraxia of speech (Rogers, 2006; Tager-Flusberg, Paul, & Lord, 2005; Wetherby, Prizant, & Schuler, 2000). Voluntary motor control is disturbed in children with dyspraxia, which also affects their ability to imitate. The new research on the

initially developing some words (Chawarska et al., 2007; Kurita, 1985). Lord, Schulman, and DiLavore (2004) found that this language regression is unique to autism and does not occur in other children with developmental delays. Chawarska et al. (2007) hypothesize that these early-acquired speech-like productions are lost by children with ASD because the link between these expressions and a network of symbolic communication fails. There is significant variability in the rate at which language progresses among children with ASD who do acquire speech.

The few longitudinal studies of language acquisition in children with ASD suggest that progress within each domain of language follows similar pathways as it does in typically developing children (Lord et al., 2004; Tager-Flusberg et al., 2005). However, the speech of children with ASD is also characterized by some typical deviations. One of the most salient aspects is the occurrence of echolalia, which can be either immediate or delayed. Although some echolalia seems to be self-stimulating, both types of echolalia can serve communicative purposes for the speaker (Tager-Flusberg et al., 2005). At an early stage of language development, this may be the only way in which the child can actually produce speech. Tager-Flusberg et al. (1990) found that, over the course of development, echolalia rapidly declined for all the children with ASD and Down's syndrome in their study. Another prominent feature of language in children with ASD is general problems with deixis, which are most often manifested as pronoun confusion (Tager-Flusberg et al., 2005). Features such as vocal quality, intonation and stress patterns often result in problems for persons with ASD, although there is a lack of research in this field. Taken together, the findings suggest that the difficulties are due not only to problems in social intent but also to problems affecting a more basic aspect of vocalization (Tager-Flusberg et al., 2005).

Less research attention has focused on the comprehension skills of individuals with ASD although deviations in response to language and comprehension have been found to be strong indicators of ASD (Dahlgren & Gillberg, 1989; Lord, 1995). According to Tager-Flusberg et al., it seems that ASD children 'not only may have limited ability to integrate linguistic input with real-world knowledge but also may lack knowledge about social events

many studies, using a variety of treatment settings and treatment deliverers, with both single-subject and group designs (Rogers, 2006). Limitations on this approach as a language-training method were recognized early on, with the children's lack of generalization being a core problem (Lovaas, Koegel, Simmons, & Long, 1973).

The pragmatic understanding of communication was fully developed after the operant teaching methods were first developed (Rogers, 2006). The current scientific understanding of communication and language development stems from the 1970s and 1980s, when it was demonstrated that language develops from the preverbal social exchanges of infants with important others (Bates, 1976). According to Rogers (2006 p. 149), 'current research, building primarily on the work of Wetherby (Wetherby & Prutting, 1984), Prizant (Prizant & Wetherby, 1998), and Sigman and Mundy (Mundy et al., 1990), has demonstrated that young children with autism lacked these early building blocks of communication, involving social initiative, joint attention, social and emotional reciprocity, and the use of gestures to co-ordinate social exchanges.'

In 1968, an important study was published by Hart and Risley. Very positive results were obtained with an intervention in which the principles of operant teaching were applied in the child's natural environment. The term 'incidental teaching' was used for this approach, in which the natural environment is deliberately structured to highlight the function of the targeted language form. This intervention produced much better results with respect to maintenance and generalization and stimulated development and research in the field (Rogers, 2006). According to Rogers (2006, p. 153), the effectiveness of this approach results from four factors: (1) child language functions to achieve child-chosen goals and child-chosen reinforcers, which strengthen their power; (2) the focus is on child communication skills that are functional in all settings; (3) the social functions of language are highlighted; (4) emphasis on child motivation and natural reinforcers adds a positive element to the interactions, which may enhance memory for learning.

The third major approach in the field of communication intervention for children with ASD is the developmental pragmatic approach. The most elaborated programme for treatment, the SCERTS (Social-Communication, Emotional Regulation, Transactional

production and/or comprehension, including spoken and written modes of communication' (ASHA, 2005, p. 1) AAC should be thought of as a system with four primary components: symbols, aids, strategies and techniques (ASHA, 2005, pp. 1–2). Symbols of various kinds can be included in an AAC system: graphic, auditory, gestural, and textured or tactile symbols, which may be unaided (such as signs, gestures or facial expressions) or aided (such as real objects, pictures, line drawings, or orthography). Aids refer to electronic or non-electronic objects that are used to transmit or receive messages, and techniques to the ways in which messages can be transmitted. Finally, strategy refers to the ways in which messages con be conveyed most effectively with respect to, for instance, timing, grammatical formulation or communication rate (Beukelman & Mirenda, 2005). According to Beukelman and Mirenda (2005), the ultimate goal of an AAC intervention is to enable an individual to efficiently and effectively engage in a variety of interactions and participate in the activities of their choice.

Von Tetzchner and Martinsen (2000) have defined three different groups of individuals who need (AAC: (1) the expressive language group, characterized by a gap between their understanding of other people's speech and their ability to express themselves through spoken language. The difficulties of this group are persistent and they need an AAC system that can be used permanently. (2) The supportive language group needs an AAC system at certain periods of their life or in certain situations and is divided into two subgroups in this respect: the developmental group and the situational group. For the developmental group, the AAC is often a step towards the development of speech. The situational group is made up of individuals who have learned to speak, but who have difficulty in making themselves understood, most often with people who do not know them well. (3) Finally, the alternative language group consists of individuals who will need their alternative language form for the rest of their lives. Intervention comprises both comprehension and production and the communication partners will also need to use the AAC mode. Von Tetzchner and Martinsen (2000) specifically mention children with autism as belonging to the third group. This is often true of children with autism and learning disabilities and definitely of those who do not develop speech. Probably the majority of

exceeded the highest data point during baseline. The PND value for nine of the ten multiple baseline design studies was 90% to 100%; for the remaining one, it was 70% to 90%. None of these studies were published after the 1980s, which might reflect the gradual change in AAC intervention for persons with autism, as it became more focused on visual-graphic communication, at least in North America. Von Tetzchner and Martinsen (2000), though, report on a Norwegian survey of 64 children and adolescents with ASD in which it was seen that progress in terms of quality of language was seen only in those individuals who had been given systematic manual sign teaching. Von Tetzchner and Martinsen (2000, p. 82) criticized the fact that manual signing interventions were being abandoned and stated that 'this limits the variety of strategies that are applied and hence opportunities for learning for autistic individuals'.

Mirenda and Erickson (2000) explain that the shift away from the use of signing to visual-graphic communication occurred as a result of research findings in three main areas: imitation, iconicity, and intelligibility. In addition to the evidence of a generalized imitation deficit in autism, there were also studies showing that some children with ASD had extremely poor sign imitation skills (Yoder & Layton, 1988) due to difficulties with motor planning, control and execution (Seal & Bonvillian, 1997). According to Howlin (2006), the shift from the use of manual signs to visual methods was also due to the fact that visual methods had proven to be effective in enhancing general skill acquisition, mainly within the TEACCH programme (Treatment of Education of Autistic and related Communication-handicapped CHildren; Schopler, Reichler, & Lansing, 1980) developed during the 1970s**.** A variety of symbol systems were also developed, beginning with Blissymbolics (Bliss, 1965; Blissymbolics Communication International, 2007) and Rebus (Widgit Software, 2002; Woodcock, Clark, & Davies, 1968), followed by Pictogram (Maharaj, 1980) and Picture Communication Symbols (Mayer-Johnson, 1981). The improvements in computer technology made these symbol sets easily available in the form of practical software packages. The development of digital cameras during the 1990s also increased the possibility of including personal photos in AAC systems, which, according to clinical reports, seemed to increase motivation and facilitate understanding of pictures, particularly for individuals with

communication boards/books using finger pointing, speech-generating devices) are rarely thought of or are believed to be out of date.

Historically, the use of speech output technologies with individuals with ASD has not been a matter of course (Schlosser & Blischak, 2001). Computer technology was introduced into educational settings for children with autism late, not only in North America, but also in Sweden. Three Swedish surveys done at the end of the 1990s (Eklöf Wicksell, 1998; Olsson, 1998; Thunberg, 2000) clearly revealed that the number of computers used at school and/or supplied by the county councils as personal communication aids was remarkably low compared to the situation for individuals with communication impairments with other causes than autism. In Sweden, professionals feared that people with ASD would become even more aloof if they were encouraged to sit in front of a computer screen. Concerning SGDs, a common view was that they would only stimulate echolalia in children with ASD, and that there would be too much noise in the classroom. By the end of the 1990s, scepticism had decreased. This was probably due to reports of some studies of successful computer-assisted instruction (CAI) carried out in Sweden. By using the interactive multimedia software Delta Messages, Heimann, Nelson, Tjus, and Gillberg (1995) showed that a group of 11 children with autism were able to make significant gains in reading, phonological awareness, verbal behaviour, and motivation. Another study within this project showed that 13 children with autism, regardless of the initial cognitive and language level, increased their reading skills and reading speed following the use of CAI (Tjus, Heimann, & Nelson, 1998). The interaction between the children and their teachers was also studied during the CAI sessions. It was suggested that the intervention promoted an increase in verbal expressions and enjoyment for the participating children, and specifically for the children with autism compared to the other children who were also included in the project. The children's verbal expressions were more relevant at the end of the study period, and this was most marked for the children at low language levels. Concerning the teachers' behaviour, it was seen that they tended to use more physical directives towards children with a low language level while the children with higher language levels received more praise (Tjus et al., 1998). Another study that attracted some attention was the work of Mandre (1997, 2002) using CAI as a tool

with autism, were given access to an SGD; through naturalistic teaching procedures, they learned to make requests, answer questions, and make social comments during natural play and/or a snack routine at their preschool. There was also an increase in classroom staff members' communicative interactions with the children. The authors speculated that this increase might be due to the recent training, but that it might also be due to the new ease of understanding the children's SGD communication. This study was done on children at a prelinguistic level, using SGDs in a school setting; the same is true of almost all of the research done in the field of SGD intervention for children (and adolescents) with ASD.

The articles on SGD intervention that were identified and referred to in the studies making up this thesis are listed in table 2. Two of them described and demonstrated the intervention model used, rather than effects of SGD use (Light, Roberts, Dimarco, & Greiner, 1998; Sonnenmeier, McSheehan, & Jorgensen, 2005). In both of these studies, models are illustrated through case reports where the outcome is anecdotally described. Light et al. (1998) presented the 'Participation model', implemented with a 6-year-old boy with autism who had severe expressive and receptive language impairments. The boy was supplied with high- and low-tech solutions, including an SGD in the form of a portable computer with speech synthesis and simple word processing software (since the boy's AAC system was alphabetically based). A follow-up two years after the implementation of the AAC intervention showed that the boy had made significant gains in both receptive and expressive communication. Sonnenmeier et al. (2005) implemented their 'Beyond Access Model' with a 10-year-old student with autism. After one year, he had expanded his vocabulary with 80 to 100 messages, used on either a portable SGD, a desktop computer or paper overlays. He used single words or combinations to convey both requests and comments.

One of the articles listed in table 2 presents a retrospective analysis (Mirenda, Wilk, & Carson, 2000). Fifty-eight students with autism from British Columbia, Canada, were supplied with SGDs by the school authorities. By studying written follow-up reports, it was seen that in a five-year period 53% of these students used their SGDs in a manner rated as successful or very successful, and the remaining students had limited or some success. Levels

using an SGD, rates of requesting and vocalization across speech output conditions (on and off) were compared. No major differences were found and the authors suggested that access to preferred objects, rather than the effect of the speech output, was the critical variable in maintaining the use of SGDs. One of the three children began to speak single words during the intervention, suggesting that SGD intervention may facilitate speech in some cases. In the next study, Sigafoos et al. (2004b) reported on an intervention to teach students to locate their AAC device or SGD, when it was not accessible. After an initial period of teaching the students to request access to preferred objects, a least-to-most prompting procedure was implemented to teach them to locate their device. The intervention proved effective in all three adolescents who participated in the study. The students were also taught to turn the device on. The speech output seemed to provide an important source of feedback the participants needed to master this skill. Sigafoos et al. (2004a) investigated whether two students at a prelinguistic level could learn to use an SGD to repair communicative breakdowns. The intervention was effective and the participants also began to use the SGDs to initiate requests even when communication breakdowns had not occurred.

The last study to be reviewed, Romski and Sevcik (1996), is the first one listed in table 2 and is also the only longitudinal study. Two individuals with autism were included in the investigation of the System of Augmenting Language (SAL), a method that has influenced the work and studies discussed in this thesis. SAL incorporates an SGD, symbol vocabulary, naturalistic teaching strategies, communicative partners augmenting their speech by SGD use, and a resource and feedback mechanism. The individuals with ASD in the study both belonged to the group of participants who achieved the best success. Although the rest of the group were not diagnosed with ASD, it should be mentioned that Romski and Sevcik suggested that factors related to speech comprehension and representational skills seemed to distinguish the advanced from the beginning achievers in their group of 11 participants (Romski & Sevcik, 1996).

All studies except one (Sigafoos et al., 2004c) were conducted in a school or clinical environment. In this exceptional case study, the transfer of the SGD intervention to the home was the focus. A model including an initial clinical trial followed by replication at home was

Table 2. Studies of SGD intervention that include children and adolescents with ASD

Authors	Year	Title	Participant(s)	Intervention	Setting, activity
Romski, Sevcik	1996	Breaking the speech barrier: Language development through augmented means	2 subjects with autism (out of 11) Age 7 and 16 Moderate and severe intellectual disability Severe spoken language impairments	SGDs with lexigrams Naturalistic teaching SAL 23–104 symbols	School or home Referential and socio-regulative words
Light, Roberts, DiMarco, Greiner	1998	Augmentative and alternative communication to support receptive and expressive communication for people with autism	1 subject with autism Age 6 Autism, no intellectual disability Early language level, some functional speech	Present and demonstrate use of the 'Participation Model' for AAC implementation Naturalistic teaching Anecdotal data on outcome Laptop, word-based communication book with large vocabulary, Remnant pocket	School and home Writing and communication Various communication functions in different activities
Schepis, Reid, Behrman n, Sutton	1998	Increasing communicative interactions of young children with autism using a voice output communication aid and naturalistic teaching	4 subjects with severe autism Prelinguistic or early linguistic level Age 3–5	Naturalistic teaching SGD, 4–8 messages	Preschool: Mealtime Play Various communicative functions
Taylor Dyches	1998	Effects of switch training on the communication of children with autism and severe	4 subjects with autism or PDD Age 10–12 Severe or profound intellectual disabilities	Simple switches with photo connected to a tape-recorder Incidental teaching, five levels of	School Request water

Sigafoos, Drasgow, Halle, O'Reilly, Seely-York, Edrisinha Andrews	2004 a	Teaching VOCA use as a communicative repair strategy	2 subjects with ASD and cognitive disability Age 16–20 Prelinguistic level	Use VOCA to repair communicative breakdown, Child-centred one-to-one instruction SGD: Big Mack	1 training centre: break-time 1 school: snack time Request food 1 message: want
Sigafoos, O'Reilly, Seely-York, Edrisinha	2004 b	Teaching students with developmental disabilities to locate their AAC device	3 subjects with ASD and cognitive disability Age 12–20 2 prelinguistic, 1 early linguistic level	Teach locating of device Child-centred one-to-one instruction (3 different trainers) SGD: TechTalk	1 training centre: break-time 2 school: snack time Request One message: I want more
Sigafoos, O'Reilly, Seely-York, Weru, Son, Green, Lancioni	2004 c	Transferring AAC intervention to the home	1 subject with ASD and cognitive disability Age 12 Prelinguistic level	Transfer intervention to home Child-centred one-to-one instruction SGD: TalkTrac	Home: mealtime and leisure Request food/ activities 4 messages (2/activity)
Sigafoos, O'Reilly, Ganz, Lancioni, Schlosser	2005	Supporting self-determination in AAC interventions by assessing preference for communication devices	2 subjects with ASD and cognitive disabilities Age 12–16 Prelinguistic level	Choice of SGD Child-centred one-to-one instruction SGDs: TechTalk, BigMack, MiniMessagemate	School: snack time. Request food One message: want
Sonnenmeier, McSheehan, Jorgensen	2005	A case study of team supports for a student with autism's communication and engagement within the general education curriculum: Preliminary report of the Beyond Access Model	1 subject with autism and cognitive disability Age 10 Early linguistic level	Presentation of an intervention model, anecdotal reports of outcome SGD: Dynamyte	School: different activities, development of 80–100 messages

functions as a 'home base' from which the child may engage in exploration of the world. Early patterns of infant-caregiver interaction can be related to quality of later attachment, which are in turn related to subsequent cognitive and social skills (Bowlby, 1969; Seifer & Schiller, 1996). It is commonly recognized, in the light of the theoretical work within the fields of language philosophy and cultural psychology, that meaning is a social construct and that speech is used to perform social acts (Austin, 1962/1976; Grice, 1989; Ninio & Snow, 1996; Wittgenstein, 1953/1967). The development of intersubjectivity is the key element in the acquisition of pragmatics and communicative acts (Ninio & Snow, 1996). The development of intersubjectivity and the closely related skills of joint attention and symbol use takes place above all in interactions within the family. For instance, Yoder and Warren (1999) found a positive relationship between parent responsibility and later language development in prelinguistic intentional communicators with developmental disabilities over a 12-month period. This led them to conclude that partner and contextual influences on children's early language development predicted their treatment prognosis. Siegel and Cress (2002) suggest that this finding indicates that AAC interventionists need to change more than children's isolated behaviours to improve communication. More knowledge of the roles of parents and early communication development has led to an increased focus on parents and early intervention.

Early intervention has become a central issue in for the treatment of children with communicative disabilities in general (Siegel & Cress, 2002); for children with ASD in particular, this issue has attracted even more attention (Beukelman & Mirenda, 2005, p. 245). Research into the effects of early intervention is very promising and, as mentioned above, it seems to decrease the number of individuals with ASD who are unable to use speech at all (Lord et al., 2004). Parental involvement in early intervention services has been emphasized, regardless of which programme is used. This involvement should encompass both planning and implementation of the intervention (Domingue et al., 2000). Dawson and Osterling (1997) found that parents experienced a greater sense of relatedness to their child, an increase in their sense of competence and feeling of well-being and a decrease in emotional stress when they were involved in their child's programme. When parents prioritize the goals to be

communicating with their caregivers at home is one exception. Communication between the children and their caregivers (focus dyads) was studied in five different activities – mealtime, game, drawing, tooth brushing and story reading – and was then compared to that of two children without disabilities (comparison dyads). It turned out that communication in the focus dyads was mostly unaided and was, in most respects, more restricted than in the comparison dyads in that it rarely extended beyond the here and now. When the communication aid (Blissboard) was used, a change was seen in this respect. Ferm suggests that apart from integrating communication aids with naturally occurring activities, there is probably a need to also construct activities that focus primarily on communication.

To some extent, the general communication of children with ASD has been studied in their home environment. These studies mainly consist of retrospective or prospective investigations of family home videos to identify early signs of autism. In summary, these studies report that infants later diagnosed with ASD paid less visual attention to people, sought others less frequently and were less likely to engage in early social communicative exchanges involving smiling at other people and vocalizing. The most significant behaviour during the second year was lack of orienting to their names (Chawarska & Volkmar, 2005). According to Seung, Ashwell, Elder, and Valcante (2006), the studies of in-home interventions for children with ASD lack data on speech-language outcomes. The study by Seung et al. (2006) reported an increase in the use and variation of single words after fathers were trained in the two communicative strategies of expectant waiting and imitation with animation.

Studies of the communication of children with ASD in relation to different activities at home have not, to my knowledge, been done. According to current theories in the field of pragmatics, the use of language varies in different activities (McDermott, 1996; Ninio & Snow, 1996). In two of the studies making up this thesis, Activity Based Communication Analysis (ACA) was used. This model, developed by Allwood (1976, 2000), builds on the theories proposed by Wittgenstein (1953/1967), Austin (1962/1976) and Grice (1989), and has been used to investigate the communication of individuals with disabilities in studies by Ahlsén (1995) Ferm, Ahlsén, and Björck-Åkesson (2004), Ferm (2006) and Saldert (2006).

Summary of the studies

General and specific aims

The general purpose of this thesis was to investigate whether and how the introduction of an SGD in activities at the homes of children with ASD would influence communication. The communication and interaction between the children and their parents in the selected activities at home was of primary interest, but the children's general adaptive development during the study period was also investigated and compared with the results of the same SGD intervention in an activity at school.

Study I

The purpose of this study was to investigate how communication and communication development in four children with ASD at different communicative levels was affected by the introduction of an SGD into activities at home.

Study II

In this study, the effects of the introduction of an SGD in three different activities at the homes of four children with ASD were compared. The ACA method (Allwood, 2000) was applied to analyse the activities and identify which specific and/or general factors seemed to influence intervention outcomes.

Study III

The main focus in this study was to study patterns of conversational topics used before and during SGD intervention in different activities in the homes of four children with ASD. Topic length – the number of contributions per topic segment – was studied in detail and the interaction between the children and their parents was discussed in relation to these results.

Table 3. Characteristics of the participants and SGD applications.

Participant	***James***	***Ben***	***Leo***	***Andy***
Age at study onset	7;6	7;0	4;11	5;6
Diagnoses	Autism Mild mental retardation Dyspraxia?	Autism Moderate mental retardation	PDD Dyspraxia?	PDD Hyperactivity syndrome Dyspraxia?
Communication	1-word utterances Limited speech Severe phonological deficits Sounds Gestures Physical manipulation	No speech Voice Sounds Physical manipulation	2–3-word utterances Severe phonological deficits Gestures	1–2-word utterances Severe phonological Deficits Voice Gestures Physical manipulation
	Situational understanding of language	Understanding of some spoken words	PPVT age 4;3	PPVT age 1;9
Language	Swedish	French, Swedish	Swedish	Swedish
SGD	Winmax + Clicker	TechTalk	Winmax + Clicker	Winmax + Clicker
Speech output	Mainly speech synthesis Digitized speech	Digitized speech (French)	Mainly speech synthesis Digitized speech	Mainly speech synthesis Digitized speech
Symbols	PCS symbols Clicker symbols Digital photos	Digital photos	PCS symbols Clicker symbols Digital photos	PCS symbols Clicker symbols Digital photos
Number of SGD messages	115	6	279	176

perceptual difficulties. He demonstrated some understanding of spoken words in both French and Swedish but had no functional speech output. He used his voice, sounds and physical manipulation of things and people to communicate. Ben went to a special school for children with mental retardation and autistic disorders, situated in his hometown. He had had no earlier experience of SGDs.

Leo

Leo's diagnosis, made by a neuropaediatrician, was unspecified pervasive developmental disorder – not otherwise specified, according to the ICD-10 (WHO, 1992) and DSM-IV (APA, 1994). At the study onset, he was five years old. At that time, he had begun to develop more speech and expressed himself in up to two- or three-word sentences. He was still hard to understand due to severe phonological deficits, judged by his speech-language pathologist to be related to problems with oral praxis. He was quite communicative but had a tendency to give up when he could not make himself understood. Leo was placed in the local preschool group with part-time individual assistance. He had had no earlier experience of SGDs.

Andy

Andy had a diagnosis of unspecified pervasive developmental disorder – not otherwise specified, according to the ICD-10 (WHO, 1992) and DSM-IV (APA, 1994). He was also diagnosed with Hyperactivity Syndrome according to the ICD-10 (WHO, 1992). Andy's diagnoses were made by a neuropaediatrician. He was five and a half years old when the study started, at which point he had just begun to develop more speech. He mainly expressed himself in one-word utterances and through physical manipulation of things and people. His speech-language pathologist judged that he had a verbal dyspraxia, which affected his speech. It was not easy to understand Andy's speech and sometimes his parents also had problems understanding him. He had difficulties regulating his voice, and often spoke very loudly, almost shouting. Andy was placed in a preschool group for children with ASD. He had tried to use a dynamic screen software with speech output implemented on a

screen software was therefore chosen: Clicker 3,[3] implemented on a portable touch-screen computer: Winmax.[4] Graphic symbols, selected from the internal Clicker base and the Picture Communication Symbols (PCS) library (Mayer-Johnson, 1981), were supplemented with digital photos. Speech synthesis (Infovox[5]) served as the main source of speech output, but some digital recordings were also used. James's vocabulary comprised 115 messages, Leo's of 279 and Andy's of 176. The messages consisted of some short phrases, mainly sentence starters, while the majority were single words. Colour-coding was used to indicate grammatical categories and different activities. For these three boys, the vocabulary was organized in three levels. Data on the SGD applications are found in table 3.

The parents of James, Leo and Andy received a half-day-course in Clicker 3 specifically focused on the commands necessary for programming and revision of their child's application. During this course, the parents had a chance to discuss their child's applications in more detail. James's and Leo's families, who both chose story reading as an intervention activity, attended a half-day course on story reading for disabled children and the use of AAC during story reading activities. All parents received guidance on how to use SGDs in daily communication during the team meetings and during home visits around the time of the introduction of the intervention in their home. They were especially encouraged to use the SGDs themselves in appropriate communication situations to augment their speech and to serve as a model for their child, according to the SAL (Romski & Sevcik, 1996). In the example 'Tommy, let's go OUTSIDE and ride your BIKE', *outside* and *bike* were symbols that were both touched on the SGD and spoken by the partner. All instructions and guidance to the families concerning the SGD intervention and SAL technique were given by the research leader.

Evaluation material and procedures

Video recordings

The video recordings were made by the parents/teacher themselves to minimize disturbance in the children's natural environments. The families/school were provided with a VHS camera and a tripod during the study period. The parents/teacher were instructed to videotape the chosen activities once a week, for approximately 15 minutes and on at least

Table 4. Characteristics of the activities and recorded material

Participant	Activity	Recording periods	Number of recorded sessions	Minutes of coded material
James	Mealtime	Baseline: Sep. SGD: Nov.	4 4	49 35
	Story reading	Baseline: Jan. SGD: Feb.	4 4	35 38
	Morning circle*	Baseline: Nov.-Dec. * SGD: Jan.-Feb.*	4 4	70 78
Ben	Mealtime	Baseline: Sep.-Oct. SGD: Nov.	4 2	51 22
Leo	Story reading	Baseline: Sep.-Oct. SGD: Jan.-April	4 3	71 30
	Sharing experiences of the preschool day	Baseline: Oct.-Dec. SGD: Feb.-April	4 3	38 93
Andy	Mealtime	Baseline: Sep.-Oct. SGD: Nov.	7 3	76 26
	Sharing experiences of the preschool day	Baseline: Dec. SGD: March-May	2 5	25 27

* This activity was recorded in the school environment during the year following the intervention at home. These data were used in study IV.

Vineland Adaptive Behavior Scales (Study I)

Interviews with the Expanded Version of the Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cicchetti, 1984) were done to assess the children's adaptive development. Development on the different subdomains of the scale during the study period (communication, daily living skills, socialization, motor skills) was compared. The domain of maladaptive behaviour in the VABS was also used. The VABS has been claimed to be

and understanding of meaning (Allwood, 2000). Activity is seen as the the basic organizing contextual aspect of social reality that influences interaction. In this method, the collective and individual factors that influence interactions during an activity are considered and qualitatively analysed to serve as a frame of reference in interpreting and discussing the linguistic factors in question. The advantage of ACA is that it combines qualitative and quantitative methods to delineate different factors of importance for understanding communicative behaviour in a specific activity. The ACA procedures used in this study were as follows.

The analysis of the collective influencing factors included a specification of the main purpose and subgoal(s) of the activity, activity structure and procedures, the general role configurations, the artefacts used and finally the physical and psychological circumstances of the activity. Taking the mealtime activity as an example, the main purpose of the activity was that the child should have a meal and the subgoals were to share some information about things that had happened during the day and to talk about the meal itself. The activity structure and procedures were also described; in the case of mealtime, this meant that the child was supposed to sit down at the table, wait for dinner to be served and then eat. The general role configurations were then characterized; in this example, it meant that the parent had the role of caregiver and the child the role of a recipient of care. The artefacts used were specified, in this case dining-room furniture, cutlery, plates, glasses, bowls and pans. The video camera and the SGD were introduced as uncommon artefacts. Finally, the physical and psychological circumstances of the activity were described; in this example, the psychological circumstances seemed to be stressful for all families.

The individual influencing background factors included in the analysis were physical and communicative possibilities, together with the individual goals, roles and procedures developed within the activity. In the example of mealtime for James, this meant that James, due to his severe phonological difficulties, was dependent upon his parents' attention and physical closeness to be able to make himself understood. Examples of individual goals, roles and procedures for James's mealtime were that both parents were very anxious and busy preparing James's food and had more time to communicate with the boy after the meal

Topic analysis (Studies III and IV)

The topic analysis methodology used in this study was developed by Ferm (Ferm, 2006; Ferm et al., 2004), influenced by the work of Brinton and Fujiki (1984), Keenan and Schieffelin (1976) and Mentis and Prutting (1991). The analysis followed four steps: (1) Each video recording in its entirety was sequentially analysed for topic segments. A topic segment was defined as a contribution or several contributions in succession that had a common main focus (topic). Words, vocalizations, word approximations and body communication that referred to the same action, activity, person, object or idea were considered to have the same focus and were regarded as belonging to the same topic segment. A major change in focus implied a change in topic segment (and topic). (2) Each topic segment was labelled with regard to its main focus (e.g., event at school), which thereafter constituted the topic of the topic segment. All topic segments with issues related to the observed activity (e.g., mealtime) were defined and labelled as 'ongoing activity'. The ongoing activity topic included (a) everything that had to do with the activity structure and practical goals, and (b) the child's or caregiver's communication and/or behaviour in relation to the implementation of the activity. (3) Each topic segment was specified for length with regard to the number of contributions involved from the initiation of the topic segment until its end. (4) Each topic segment was coded with regard to whether it had been initiated by the child or the parent. The amount of video material analysed with respect to topics totalled 11 hours and 30 minutes, collected on 54 occasions.

Reliability and validity

Randomly selected sections comprising 10% of the video recordings of each participant, intervention activity and phase were analysed by another observer to check for interobserver agreement. This observer was the local speech-language pathologist for two of the participants. The second observer was trained in the procedures of communication coding and topic analysis for approximately eight hours. Agreement was checked for every common communicative contribution according to the five dimensions of the coding scheme. Concerning communicative mode, where more than one feature could be coded, at least 50% of the coded features of one contribution had to be identical in order to be judged as concordant. Interobserver agreement was calculated for each dimension of the coding scheme using the formula agreements / (agreements + disagreements) x 100. The interobserver

Results and conclusions

Study I

Results

The purpose of this study was to investigate how communication and communication development in the four children was affected by the introduction of the SGD in activities at home. The results of the communication coding varied according to the child and the activity being studied. Communicative effectiveness, however, showed a general increase during the intervention phase for all children and all activities. The measure of engagement in activity increased in five of the seven settings. The same result, an increase in five out of seven settings, was also seen for the rate of responses. The observations showed that the SGD seemed to facilitate comprehension and provide a contextually relevant vocabulary, which resulted in more responses. The child at an early linguistic stage was able combine words into sentences by using his SGD. One strong tendency for the three children who were able to speak was a decrease in the use of prelinguistic forms (physical manipulation, eye contact, gesture, vocalization) when the SGD was introduced. For the child (Ben) who was at a prelinguistic level, the use of both prelinguistic and linguistic modes increased. Adaptive development, measured by the VABS, showed that all children developed markedly during the study period compared to other children with autism. The development was, however, general, affecting all domains, rather than specific, even though development in the subdomains of communication and socialization was more pronounced. Maladaptive behaviour was substantially reduced for two of the children.

Conclusion

Children with different profiles within the autism spectrum and at different communicative levels can learn to use an SGD to communicate more effectively with their parents in different activities in the home environment. SGD intervention has a positive effect on adaptive development and may reduce maladaptive behaviour in some children

Study III

Results

The topic analysis showed that the share of communicative contributions on topics outside the ongoing activity decreased for all children and in all activities when the SGD was introduced. This was most noticeable for the two children who were able to speak, whose introduction of irrelevant topics was quite extensive before the intervention. Topic length – the number of contributions per topic segment – increased during SGD use in five out of the six studied settings. The overall increase was not very great, since there was a lot of variation between the children, between the activities and sometimes also within the baseline and intervention phases of a specific activity.

Conclusion

Access to an SGD can decrease irrelevant speech and increase the number of contributions within the topic of the ongoing activity. For children with ASD who produce a lot of irrelevant speech, this is a very positive effect, whereas is the benefits are not as obvious for children who have more expressive problems. Instead, these children might need AAC applications that facilitate topic shifts, like children with expressive difficulties in combination with diagnoses outside of the autism spectrum. Interaction, as measured by topic length, can be increased through SGD intervention. The access to a relevant and easily accessible vocabulary, both visually and auditorily available to both the child and the parent probably facilitates communication and interaction.

Study IV

Results

In this case study, the ACA method was used to compare the results of communication coding and topic analysis in two activities at home (mealtime, story reading)

General discussion

SGD use at home

The general purpose of this thesis was to investigate whether and how the introduction of an SGD in activities at the homes of children with ASD would influence communication. The analysis of video-recordings from the children's homes before and during intervention showed that communication changed when the SGD was introduced. These changes varied between the children and were influenced by the specific activities. The general result showed that communicative effectiveness – the ability to make oneself understood and/or attract the communication partner's attention – increased for all four participating children during all activities studied in the home environment. For the two children with more functional speech, the use of irrelevant conversational topics decreased. The vocabulary available on the SGD, both visually and auditorily, seemed to facilitate communication and make it more concrete. This was also reflected in the analysis of roles in turn-taking, where the children were more likely to take the responding rather than the initiating role during SGD use. This was considered a positive trend since children with autism, mainly due to problems with intersubjectivity and attention, typically have problems responding to their partners' communication (Bishop et al., 1994; Tager-Flusberg et al., 2005). In most situations, topic length – the number of contributions within a topic segment – increased. Another general trend was a decrease in attention-directing behaviour. It was suggested that the SGD communication is easier for the parents to perceive, which was also proposed by Schepis et al. (1998) and Sigafoos et al. (2003) in their studies of SGD use. Another explanation of this change might be the instruction to the parents to use the SGD when talking to the child. This meant that the parent and the child came closer to each other and shared a common ground for their communication.

Linguistic level and SGD use for children on the autism spectrum

The children in this study were all diagnosed within the autism spectrum, but they differed with respect to their specific diagnoses, problems and resources. One of the children, Ben, was at a prelinguistic level while James was slightly more able, judged as being at an early linguistic level. His difficulties with voluntary oral motor control were considered to hinder his communicative development. The two five-year-old children had a diagnosis of PDD and both began to use more functional speech after they entered the project. Since they still had problems communicating during many activities and their parents were very motivated, it was decided that they should be included in the study. Another reason was that no studies were found concerning SGD use in this population. Both families chose to use the SGD during the activity of 'sharing experiences of the preschool day'. The topic analysis showed a marked decrease in the use of irrelevant topics by both boys. One of the two boys, Leo, was also able to initiate topics concerning the preschool day and his topic length increased markedly. The other two activities selected for these more linguistically advanced boys were mealtime and story reading. Although communicative effectiveness in these activities increased with access to the SGD, the positive effects were more limited. Less favourable psychological circumstances, described in the activity analysis, were probably the cause.

For the two children who were at earlier linguistic levels, the introduction of the SGD gave them the means to express themselves. Ben became able to use language and James to combine words into sentences. Topic length increased for both boys, indicating that they could interact more with their communication partners. These findings lend support to the earlier research into SGD use that suggests that children with autism can use SGDs to learn early linguistic behaviour, mainly requesting (Brady, 2000; Taylor Dyches, 1998; Durand, 1999; Sigafoos & Drasgow, 2001; Sigafoos et al., 2003; Sigafoos et al., 2004a; Sigafoos et al., 2004b; Sigafoos et al., 2004c; Sigafoos et al., 2005). The positive results of the SGD intervention with respect to the participants' different communicative levels and ASD profiles support the suggestions made by Mirenda (2003) and Mirenda et al. (2000) that

SGD use at home and at school

For one of the participants in this project (James), SGD use was studied in one activity at school: morning circle. ACA was used to identify the activity characteristics and to analyse and compare the linguistic data with the corresponding results from the two activities in the home environment: mealtime and story reading. The comparison of SGD use in different environments was considered interesting since almost all research into the effects of SGDs has been done in schools or clinical environments. Consequently, there is limited knowledge of their environmental effects. The common problems regarding generalizing in individuals with ASD contribute to the relevance of the comparison of SGD use in different activities and environments. The activity analyses showed that the morning circle at school shared many characteristics with story reading at home. In both activities, a strict role pattern and activity structure was applied that was controlled by the adult in the role of teacher/trainer. A shared goal was to teach and train in language. The very specific changes with respect to the linguistic data before and during intervention were also very similar. This meant that the child's use of responses and the communicative function of 'answering questions' increased. In both activities, the parent or teacher intermittently asked the child to answer orally, not only with the SGD, which lowered the rate of effective communication. The characteristics of the activity seemed to be more closely linked to the linguistic outcome of the SGD use than did environmental factors.

The results during mealtime in studies III and IV may at first glance be interpreted differently, since the intervention proved to be less effective despite the many studies done in schools and clinics that report positive outcomes. It must therefore be pointed out that in the activity analyses the psychological circumstances were revealed to be stressful during mealtime in all families. Again, this points to the usefulness of ACA in comparing activities, children and environments. ACA could also be used as a support in decision-making within the framework of a family-oriented collaborative problem-solving model, to identify positive and negative factors in the activities. The recommendation to choose activities in which communication is the main goal is consistent with the suggestions made by Ferm (2006) in

observed at school for one of the children. This means that the contributions by the children led to more responses and attention from the parents when they had access to SGDs. During the morning circle activity, the lack of any increase in effectiveness was due to the fact that the teacher responded to the boy's SGD use by asking him to answer orally. This behaviour was also observed in the story reading activity in the boy's home, where the father took on the role of teacher/trainer. Occasionally, this pattern was noted in Leo's family. Education to the parents were included in the intervention, but mostly concerned the handling of software and hardware. There was also instruction on how to use the SGDs in interaction, but the results point to the need for more detailed instructions concerning communication and communication training. The families included in the project were very positive to SGD use and played an active role in decision-making concerning intervention activities and the content of applications. However, as noted above, they sometimes had problems using the SGD interactively according to these initial plans. Parents' drive to teach children and to favour oral speech over other forms of communication seems to constitute part of human motherese (Volterra, Caselli, Capirci, & Pizzuto, 2004). When a child lacks the necessary prerequisites, problems arise and negative and unproductive patterns are often established in the interaction between parents and children (Mahoney & Powell, 1988; McCollum & Hemmeter, 1997). It is therefore crucial for parents to get help in the form of more knowledge of the communication process and awareness of their own behaviours, which are partly congenital and unconscious. Moreover, to be able to change their own behaviours, parents need instruction and training in interactive strategies and the use of augmentative communication, probably with video feedback included. Other researchers in AAC, autism and early intervention have also pointed out the need to work more on instructional techniques, primarily for parents (Beukelman & Mirenda, 2005; Freeman, 1997; Light et al., 1998; Mirenda, 2003; Prizant et al., 2000; Quill, 2000; Rogers, 2006; Siegel & Cress, 2002, Wilder, Axelsson & Granlund, 2004).

The parents were instructed to also use the SGD in their communication with the child, when it seemed appropriate. This instruction may have contributed to an increase in interaction, as was suggested by Cafiero (2005), Morell (2005, 2006), and Romski and

teacher. For Leo and Andy, their comprehension of preschool topics seemed to increase and they responded better from a pragmatic point of view.

Clinical implications

The participating children, who were at different levels of communication development although they were all diagnosed with ASD, were able to use SGDs in different activities at home to improve their communication. Positive changes in communication were also seen during the compared activity at school. Communication and SGD use varied in the different activities. Communicative effectiveness increased most in the activities where communication was the main goal. The activity analysis (ACA) proved to be useful in this and other respects, as mentioned above, and ought therefore be adapted to clinical use. Mealtime, the most researched SGD intervention activity in clinics and school settings, might not be equally appropriate for intervention in the home, since there often is a lot of stress associated with eating by children with autism (Baranek, Parham & Bodfish, 2005). In family-centred intervention models, it is recommended that the intervention be embedded within natural family routines (Domingue et al., 2000; Moes & Frea, 2002). This is the basic idea, but for communication intervention in the home it seems particularly important to focus on activities with clear communicative goals, in order to avoid letting the communication 'drown' in the other practical goals that parents have to manage in their homes.

Parents' strong drive to reinforce oral speech was noted in this study. It is necessary to make parents aware of this phenomenon, when introducing AAC, so the child's new means of communication can be used functionally. The instructions given to the parents seemed to be insufficient and it appears that AAC intervention in the home should be preceded by parental education about the bases of communication and strategies to enhance interaction and communication.

SGD use had positive effects for all children in this study, including the two boys who mainly used speech to communicate and could be defined as belonging to the supportive language group (von Tetzchner et al., 1996). Because SGDs are quite expensive to buy and a

- Effects of family factors.
- Effects of AAC intervention on how parents perceive their situation.
- Effects of parental education in communication, communication strategies and use of AAC techniques in interaction.
- Effects of techniques for modelling AAC use (e.g., SAL).

There is also a need for more qualitative research in the field of communication intervention for children with autism. And there is a great need for more studies of different interactive and communicative aspects in connection with SGD and/or AAC intervention, using:

- Activity Based Communication Analysis (ACA).
- Conversation Analysis.

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Communication Using Speech-Generating Devices - A Study of Four Children with Autism Spectrum Disorders at Different Stages of Communication Development

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Key words: Autism spectrum disorders, Augmentative and alternative communication, Speech-generating device, Voice output communication aid, Intervention, Communication development, VABS

Introduction

Autism and Augmentative and Alternative Communication

Problems within the area of language and communication belong to the main characteristics of children diagnosed with autism spectrum disorders (American Psychiatric Association, 1994; World Health Organization, 1993). Approximately 50% of individuals with autism do not develop sufficient natural speech to meet their daily communication needs (Wing & Attwood, 1987). Among the speaking children with autism,language tests show that there is a wide range of performance, where about 50 % have been found to have significant language impairment (Tager-Flusberg, 2004) . The majority of individuals with autism spectrum disorders (ASD) could on these grounds be expected to benefit from some kind of augmentative communication support, permanently or during some periods in their life (Cafiero, 1998; Light, Roberts, Dimarco, & Greiner, 1998; Mirenda, 2003; Quill, 1997; Sigafoos & Drasgow, 2001). The significant progress within the area of information and communication technology offers individuals with autism new ways to express themselves. Documentation about intervention and intervention studies, where modern multimodal technology is used to support expressive functions, have however been very limited (Heimann & Tjus, 1997; Thunberg, 2000). According to two comprehensive reviews of papers on augmentative and alternative communication (AAC) different approaches were compared, (Mirenda, 2001, 2003), among them voice output communication aids (VOCAs, the term that is now being replaced by speech-generating devices). In this review it was clear that the few studies using computers and VOCAs as tools for communication gave positive results. A more recent meta-analysis of outcomes of different types of AAC-intervention for children with autism, confirms these results (Wendt, Schlosser, & Lloyd, 2004). Both group data and single subject data were collected and analyzed in this study. To compare outcome values for the single subject studies the measure of Percentage of Nonoverlapping Data (PND) was used, i.e. the percentage of data points during intervention exceeding the highest data point during baseline. The result of the category of SGD intervention was found to reach a median PND-value of 86%, which is considered as fairly effective. The

SGD intervention for Children with Some Functional Speech

There are two case studies, where the participants were at a more advanced language level, both cases receptively reaching a three-year-level (Light, Roberts, DiMarco, & Greiner, 1998; Schlosser, Blischak, Belfiore, Bartley, & Barnett, 1998). However, both boys had very little or poor speech and in both cases the part of intervention that was SGD-based was mainly aimed at supporting written communication. In the study by Schlosser et al. the boy's spelling was more efficient when he got access to both visual and auditory feedback through speech synthesis. Nothing was reported on other speech or language development. The Light et al. article was primarily aimed at presenting and discussing a model for AAC assessment and intervention planning and the case study is presented as an illustration. Outcome data is therefore scarce, but the information given tells that the boy made significant gains in both receptive and expressive communication as well as in spelling. One adolescent with autism in the study by Romski and Sevcik (1996) was at a 3-year level receptively. The outcomes reported were positive and the boy demonstrated achievement within five of the seven domains specified in the study.

Besides these empirically based data there are also some clinical reports. In a project in Sweden, seven children with autism, aged between five and 13, were supplied with symbol based dynamic screen software with digital and synthetic speech output, implemented on portable touch-screen computers (Morell, 2005). All children had poor speech output and were comparatively more advanced in their understanding of language. Most of them also used PECS for communication. The vocabularies of the children in this project were in most cases more extensive than in the studies reported above, and in four cases the applications comprised some hundred messages. It was suggested that the factor that seemed to be most decisive for the children's use of the SGDs, was if the other persons in the environment also used the SGD, functioning as models to the child with autism (Morell, 2005). The second most important factor according to Morell (2005) was the behavior of the children themselves. Children, who independently explored their SGDs, seemed to be more successful compared to children who were passive and did not use the SGD by themselves.In another project at a special school for children with autism in Sweden, a SGD was used to support

James

James was diagnosed with autism (according to the International Classifation of Diseases (ICD) – 10; World Health Organisation, 1993) and mild mental retardation (assessed with Griffiths developmental Scales, Griffiths, 1970) by a neuropsychiatrist. He was seven and a half years old when the study started and eight years and four months old when the final observations were made. James attended a special school for children with autism disorders, situated in his hometown. At the start of the study he had only limited speech consisting of approximately ten words mainly being learned by imitation of a small SGD (ChatBox[1]). This SGD had been provided by the local rehabilitation team when he was six years old. He was very interested in this device, but did not understand how to use it for spontaneous communication. The words he had learned by imitation of the ChatBox could, however, be used functionally. Using these words, his voice, sounds, gestures and physical manipulation of items and people, he managed to make himself understood in routine situations at home, but had difficulties in other situations and among people who did not know him well. His expressive ability was restricted mainly due to a severe verbal dyspraxia, judged by his speech-language pathologist.. James' understanding of spoken words was judged by his speech-language pathologist to be restricted, but higher than his expressive ability.

Ben

Ben was diagnosed with autism and moderate mental retardation, according to the ICD 10 (WHO, 1993), by a neuropsychiatrist. He was seven years old when the study started. Ben went to a special school for children with autism, situated in his hometown. The language situation in Ben's home was complex. Since his mother was a native speaker of French and the family had lived in several European countries, French, Swedish, German and English had been used at home. At the time of the study, Ben's mother mainly spoke French to him and the rest of the family and society spoke Swedish. Ben had no functional speech output. He used his voice, sounds and physical manipulation of things and people to communicate. Ben demonstrated some understanding of spoken words both in French and Swedish. Ben's interest and understanding of speech and auditory input was judged by his family, teachers and therapists to be better than that for pictures and visual information.

Table 1. Characteristics of the participants and SGD-applications.

Participant	James	Ben	Leo	Andy
Age at study onset	7:6	7:0	4:11	5:6
Diagnoses	Autism Mild mental retardation Dyspraxia?	Autism Moderate mental retardation	PDD Dyspraxia?	PDD Hyperactivity syndrome Dyspraxia?
Communi-cation	1-word-utterances Limited speech Severe phonological deficits Sounds Gestures Physical manipulation Situational understanding of language	No speech Voice Sounds Physical manipulation Understanding of some spoken words	2-3-word utterances Severe phonological deficits Gestures PPVT-age 4:3	1-2-word utterances Severe phonological deficits Voice Gestures Physical manipulation PPVT-age 1:9
Language	Swedish	French, Swedish	Swedish	Swedish
Symbols	PCS-symbols Clicker symbols Digital photos	Digital photos	PCS-symbols Clicker symbols Digital photos	PCS-symbols Clicker symbols Digital photos
SGD Speech output	Speech synthesis mainly Digitized speech	Digitized speech (French)	Speech synthesis mainly Digitized speech	Speech synthesis mainly Digitized speech
Number of SGD messages	115	6	279	176

Intervention Activities, Material and Procedures

A family-centered collaborative problem-solving model originally developed by Björck-Åkesson, Granlund and Olsson (1996) and adapted for AAC-intervention by Zachrisson, Rydeman and Björck-Åkesson (2001) was used as a basis for the intervention. Decisions concerning choice of intervention activities and design of the SGD-application were taken

themselves, as judged appropriate, to augment their speech and to serve as a model to their child, according to the System for Augmenting Language (SAL; Romski & Sevcik, 1996). According to SAL, partners are instructed to integrate the use of the SGD in natural communicative interaction. In the example 'Tommy, let´s go OUTSIDE and RIDE your bike', outside and bike were symbols both touched on the SGD and spoken by the partner (Romski & Sevcik, 1996). The SGDs were mainly used in the specific intervention activities but all children and parents were allowed and encouraged to use the SGD when or wherever they desired.

Table 2. Characteristics of the activities and recorded and coded material

Participant	Activity	Recording periods	Number of recorded sessions	Minutes of coded material
James	Mealtime	Baseline: Sep	4	49
		SGD: Nov	4	35
	Story reading	Baseline: Jan	4	35
		SGD: Feb	4	38
Ben	Mealtime	Baseline: Sep-Oct	4	51
		SGD: Nov	2	22
Leo	Story reading	Baseline: Sep-Oct	4	71
		SGD: Jan-April	3	30
	Sharing experiences of the pre-school day	Baseline. Oct-Dec	4	38
		SGD: Feb-April	3	93
Andy	Mealtime	Baseline. Sep-Oct	7	76
		SGD: Nov	3	26
	Sharing experiences of the pre-school day	Baseline: Dec	2	25
		SGD: April-May	5	27

Experimental Design, Material and Procedures

A multiple single-case study design (Hegde, 1994) was used to assess the effects of the intervention in the chosen activities. The interventions were video recorded in the homes of the families by the parents themselves to minimize disturbance in the children's natural environments. All families were provided with a VHS-camera placed on a tripod. The parents were instructed to videotape the chosen activities once a week, approximately for 15 minutes and at least on four occasions before intervention started and four occassions during the intervention. All four families preferred to start intervention in one activity at a time.

standardized instruments of early language ability. The PPVT has been translated into Swedish and is often used by speech language therapists. However, only two of the children managed to co-operate in the test procedure. Therefore PPVT scores only for Leo and Andy are accounted for below and in table 1.

Transcription and Coding

Some of the collected video material was first pilot coded by the research leader according to the Communication Coding Scheme (CCS) (Romski & Sevcik, 1996). This procedure was found to be useful to form a basis for an expanded coding scheme (appendix 2) and a detailed manual with operational definitions (appendix 1). Since the degree of engagement in the activities was observed to shift, a scale incorporating five degrees of engagement was designed and added to the scheme. In the CCS, coding of communicative function was also incorporated. These data were not included in this study and were consequently not presented in appendix 1.

The coding procedures first involved a review of each observation occasion in its entirety to determine the degree of engagement for this specific occasion. Notes on interesting sequences of interaction and communication during this occasion were also taken. These notes constituted the basis for the anecdotal data presented in the study. Next followed the more detailed coding. Each contribution on behalf of the child was broadly transcribed and then coded with respect to the degree of engagement in activity, role in turn-taking, mode, and communicative effectiveness (ability of making oneself understood and/or attract attention: appendix 1). Every contribution was observed several times before all dimensions on the form were completed. The amount of coded and transcribed video material totalled 11 hours collected during 54 occasions.

Analysis of coding results

The data for each observation occasion was summarized. Due to the few and the varying number of recorded occasions (table 2) no statistical analyses with respect to differences between the phases of before and during intervention were done. Of the same reason and also due to the varying amount of time that passed between the recordings, a presentation in the

was done for the observed occasion as a whole, total agreement was found for the checked activity.

Data on internal validity in the form of treatment integrity with respect to the parent´s use of the SAL-technique (e.g. use of the SGD in their communication to the child) was also calculated analogous to the interobserver agreement, as recommended by Schlosser (2003). An agreement was scored when the experimenter and the observer both recorded the same response (adult SGD-use). The parents had been instructed to use the SGDs according to their judgement of appropriateness in the situation and the number of SGD-activations consequently varied in the different families and activities. All parents used the SAL-technique and the mean results of agreement for the two observers for all activities and parents were 87%.

Results

James

Video Analyses and Observations

As seen in Table 3 the introduction of the SGD did not affect James' engagement in the specific activities to any considerable extent: during the mealtime activity engagement was slightly lowered and during story reading the level of engagement stayed at the same level. The coding results for 'role in turn-taking' varied between the two activities. During mealtime James rate of responses increased while it decreased slightly during story reading (Table 3,). The most remarkable change in the coding of communicative mode was the decrease in the rate of vocalizations seen in both activities (Table 3). During mealtime eye contact increased while it decreased during story reading. Finally 'communication effectiveness´ increased in both activities (Table 3).

SGD. At this early stage James' father simply seemed to be too busy to manage the new reading situation, trying to use the SGD, and missed out to attend to these new behaviors and instead regained the reading initiative.

VABS Results for James

James' parents were interviewed with VABS on two occasions during the study period. According to the autism norm group data James made some progress in three of four domains on the VABS, namely communication, daily living skills and motor skills (Table 4). James' amount of maladaptive behavior stayed the same during the study period.

Table 4. Pre-post-intervention scores on the Vineland Adaptive Behavior Scales Survey Version.

	James				Ben				Leo				Andy			
	Raw score		Autism %-ile		Raw score		Autism %-ile		Raw score		Autism %-ile		Raw score		Autism %-ile	
Occasion	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Subdomain																
Communication Domain SUM	37	43	65	70	13	19	20	40	51	68	40	70	38	52	20	45
Daily Living Skills Domain SUM	62	71	75	80	27	29	30	35	82	98	80	95	74	84	75	85
Socialization Domain SUM	43	42	65	65	26	30	40	50	43	65	50	90	41	49	40	65
Motor Skills Domain SUM	56	60	80	85	44	49	50	65	52	62	60	90	60	63	85	95
Maladaptive Behavior Domain	14	14			26	28			11	7			29	16		

Ben

Video Analyses and Observations

Since Ben made so few communicative contributions, the raw scores, not percentages, are shown in Table 5. There was an increase in engagement in activity and communicative behavior over all. When the SGD was introduced, Ben immediately began to use it spontaneously, which was reflected in an increase of initiations. Concerning communicative form, gestures and vocalizations increased during intervention. Communicative effectiveness also increased (Table 5).

Leo

Video Analyses and Observations

Table 6. Leo: mean coding values for the observation occasions without (-) SGD and with (+) SGD

Activity	Story reading		Sharing experiences	
SGD -/+	-	+SGD	-	+SGD
Engagement	4.3	3.7	1.7	4.0
Contributions (n)	140.3	21.0	75.0	152.3
Role in turntaking (%)				
Response	65.4	84.7	72.8	62.6
Initiation	34.6	15.3	27.2	37.4
Mode (%)				
Phys man	1.4	1.2	2.5	1.1
Eye contact	1.1	2.4	13.0	10.2
Gesture	25.0	9.3	18.2	8.0
Graphic	0	2.8	0	4.6
SGD+Graphic	-	33.1	-	25.1
Vocalization	5.3	4.0	21.1	10.0
Speech	67.2	47.2	45.1	41.0
Effectiveness (%)				
Effective	72.5	83.6	71.8	90.6
Not clearly effective	16.0	9.5	16.6	2.2
Unsuccessful	11.4	6.9	11.6	7.2

'Degree of engagement' varied between the two activities (Table 6). During 'sharing experiences of the pre-school day' Leo's engagement markedly increased when he got access to the SGD while it decreased during story reading (Table 6). Concerning 'role in turn-taking' there was also an opposite change between the activities. During story reading Leo's response rate increased while the rate of initiatives decreased (Table 6). During 'sharing experiences' the initiatives increased while the responses decreased (Table 6). The coding results for 'mode' showed that the use of gestures, vocalizations and speech decreased when the SGD was introduced (Table 6). Finally, results for communication effectiveness increased (Table 5).

Andy

VideoAnalyses and Observations

Table 7. Andy: mean coding values for the observation occasions without (-) SGD and with (+) SGD

Activity	Mealtime		Sharing experiences	
SGD -/+	-	+SGD	-	+SGD
Engagement	1.9	2.3	1.0	2.6
Contributions (n)	39.6	33.0	37.5	22.6
Role in turntaking (%)				
Response	41.2	63.6	46.7	49.6
Initiation	58.8	36.4	53.3	50.4
Mode (%)				
Phys man	2.3	3.4	5.3	0
Eye contact	14.8	3.4	14.3	3.7
Gesture	33.8	20.4	20.3	5.9
Graphic	-	1.4	0	2.2
SGD+Graphic	-	12.9	0	9.6
Vocalization	13.6	21.1	7.5	9.6
Speech	35.5	37.4	52.6	69.1
Effectiveness (%)				
Effective	56.7	61.6	53.3	67.3
Not clearly effective	20.2	18.2	12.0	6.2
Unsuccessful	23.1	20.2	34.7	26.5

The coding results for Andy showed that the engagement in the two activities was low but that the introduction of the SGD slightly increased Andy's engagement (Table 7). The change in communication was mainly reflected in an increase of responses. Studying the dimension of communicative form Andy decreased his use of gestures and eye contact during intervention while his use of speech increased (Table 7). Andy's rate of effective communication increased during SGD intervention (Table 7).

The observations showed that Andy was very active and impulsive and had problems to sit still for more than a few minutes. He was often obsessed by something, which he insisted to communicate about (for example wanting to buy a specific toy). The observations indicated

The dimension of 'engagement in activity' most often showed a positive change in that the children were more engaged when they had access to their SGDs. Concerning the two activities with a negative trend, the children's motivation to communicate seemed to be insufficient. In one case the boy 'was just too hungry' (James, mealtime) according to his parents and in the other case the boy seemed to lose his motivation (Leo, story reading). Concerning 'role in turn-taking' the introduction of the SGD most often resulted in a change even though the distribution between initiative and response varied a lot. In AAC intervention it is often the case that an increase in the child's initiatives is regarded as a positive result. Our experience and these results indicate that this is not always the case when it comes to children with ASD. These children may be able to initiate, although not always adequately, but often they have extensive problems to respond, due to lack in comprehension of the communication process. This phenomenon is described in the literature (Tager-Flusberg, Paul & Lord, 2005). In five of the seven activities in this material, the rate of responses actually increased. The anecdotal data supported the idea that the SGD seemed to facilitate comprehension and provided a contextually relevant vocabulary, which resulted in more responses.

Looking at the coding of 'form', no single category was influenced during intervention (with the exception of SGD-use). One strong tendency though, at least for the three speaking children, was a decrease in the use of prelinguistic forms (physical manipulation, eye contact, gesture, vocalization) when the SGD was introduced (Table 3, 5, 6, 7). The categories affected varied between activities and children. During the activity of reading stories,'eye contact' decreased for both children (Table 3, Table 6) due to the problems of having to attend to the pictures on the SGD and in the book at the same time. The tendency of replacing prelinguistic forms with linguistically more advanced ones differs somewhat from the study by Schepis et al (1998) where the introduction of a SGD seemed to stimulate both linguistic and prelinguistic communicative behaviors. The children in the Schepis study were all at a prelinguistic or very early linguistic level and so it was interesting to note that the tendency to increase use of prelinguistic and linguistic forms was seen for Ben (Table 5), the child in our study that matched the participants in the Schepis study.

output, according to observations, sometimes elicited spontaneous speech imitation. In James' case almost all of his active vocabulary, according to reports from his parents and rehabilitation team, had been learned through SGD-imitation. Maybe it is the possibility to repeatedly and independently elicit the target words that makes the difference. A question that may be raised was if the SGD-use and imitating behaviors just were ordinary examples of effect play and/or echolalic behavior. The borderline between echolalia and voluntary imitation is hard to draw. If the behavior coded as imitation in this study to some extent could be echolalic seems of less importance, since it in any case, seemed to be productive. Children's functional use of rehearsal has lately been highlighted by Oxley (2003), in her studies of memory and strategic demands of SGDs. She proposes that 'allowing pre-schoolers to 'play' with their communication device by repeatedly pressing buttons may facilitate procedural memory for which utterance is elicited by which key'(Oxley, 2003). There are indications that use of other AAC-techniques such as PECS and manual signing also stimulates speech development (Howlin, 2006). It might be that the communication possibilities that are given irrespective of AAC-mode used facilitates development of language and speech. However, the possibility for the child to independently evoke speech and simultaneously look at a picture or symbol by use of the SGD, seems to further facilitate understanding and learning of sounds and words and to stimulate imitation and production. There is a need for research of long-term effects of AAC-use and comparisons of effects of different AAC-techniques for children with different profiles of ASD on communication and speech development.

With a reservation for the lack of standardized Swedish instruments measuring communication development, the conclusion was that communication development was strengthened when the children in this study had access to SGDs. This result supports earlier positive findings (Light et al., 1998; Schepis et al.,1998; Sigafoos et al. 2003; Sigafoos et al 2004), which is important since many parents still worry that introduction of a SGD will restrict their child's speech development instead of supporting it. This was the case in one of the families in this study. As noted, Leo reduced his own speech during SGD intervention (Table 6). This worried the parents, despite the fact that his communication and language

Limitations

There are limitations in this study, which is one of the first studies being done in the home environment. The most important limitation concerns the small number of participants (four) which makes it impossible to generalize the results to other children with ASD.

The following limitations concerned the method of collecting data. The families recorded the activities themselves which proved to work in two families (James, Ben), but in the other two families this worked less well, and the time interval between recordings without SGD and with SGD was outdrawn in some activities (Leo, story reading and Andy, sharing experiences of the preschool day). The effect of maturation is therefore extra hard to rule out during these circumstances. Another limitation connected to the methods applied was the interview format used in the VABS and that the interview was done by the researcher. The risk of compliance increased, especially considering that the parents themselves were so highly involved in the intervention. Another explanation to the improvements seen during intervention periods might also be that participants were given more positive attention during these phases or that the were effects of novelty. This points to another weakness, namely that no follow-up observations or withdrawal phases were included in the study. More observations occasions could also have contributed to stronger conclusions. Another limitation was that only 10% of recordings were checked for reliability and treatment integrity. It is important to consider that the communication coding was a time consuming procedure and that a lot of video data was collected in the study. Another problem in this study as in most other studies of AAC intervention was related to influences of vocabulary selection. The vocabulary selected for AAC-use has to meaningful and motivating for the individual or otherwise it will not be learned or used. This means that some differences in outcome actually may depend on the degree to which the vocabulary was suited to the child, the parents and the activities. In this study the vocabulary selection was done in team collaboration with the parents. During some observations the feeling was that some more ‘funny messages’ or some messages on other topics might have changed communication results.

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STUDY II

Abstract

The communication of four children with autistic spectrum disorder was investigated when they were supplied with a speech-generating device (SGD) in three different activities in their home environment: mealtime, story reading and 'sharing experiences of the preschool day'. An activity based communication analysis, in which collective and individual background factors for the activities were outlined, was used as a basis for the discussion of linguistic coding data derived from video-recordings made before and during SGD intervention. The coded communicative behaviours were engagement in activity, role in turn-taking, communicative form, function and effectiveness. An increase in communicative effectiveness was more noticeable when the SGDs could be used to fulfil goals and roles within the activity. The instruction to the parents to use the SGDs in their communication with the child had an important influence on the activities.

two activities in the home (Sigafoos, O'Reilly, et al., 2004b). The analyses showed that the boy very quickly transferred his knowledge of SGD use to the home setting.

Due to the lack of empirical data, it seems relevant to share some experiences from a clinical project in Sweden where the SGD intervention was mainly home-based. Seven children with autism, aged between 5 and 13, were supplied with symbol-based dynamic screen software with digitized and synthetic speech output, implemented on touch-screen computers (Morell, 2005). It was reported that the majority of the children used their SGDs every day, while others used them as a support in specific situations. Morell (2005) suggested that the most decisive factor for the children's use of the SGDs seemed to be whether the parents and staff also used them, as models for the child with autism.

The lack of research done in the home environment is striking and challenging for many reasons, especially since one of the most salient features in individuals with autistic spectrum disorders is that they have problems generalizing (Wing and Attwood, 1987). Outcomes of a specific intervention in one setting may not be applicable to another setting or activity. This means that only limited evidence-based advice can be given to parents on how to manage augmented communication in their homes. Furthermore, most researchers in the field of pragmatics and communication intervention now agree that everyone's communicative behaviour varies a lot in different social activities (Allwood, 2000; Beukelman and Mirenda, 2005; Ninio and Snow, 1996). One framework aimed to study and describe this phenomenon is Activity Based Communication Analysis (ACA) (Allwood, 2000), which also has been adapted to and used in clinical research (Ahlsén, 1995; Ferm, 2006; Ferm, Ahlsén and Björck-Åkesson, 2004; Saldert, 2006). ACA builds on the ideas of Wittgenstein, in which context is claimed to play a major role in the production and understanding of meaning (Allwood, 2000). Activity is seen as the 'the basic organizing contextual aspect of social reality that influences interaction'. Using this method, collective and individual factors that influence interactions during an activity are considered and qualitatively analysed to serve as a frame of reference in interpreting and discussing the linguistic factors in focus.

Method

The research methodology used in this study was a mixed methods case study analysis of four participants and their parents communicating in one or two of the following activities in their homes: mealtime, story reading and 'exchanging experiences of the preschool day'. The qualitative analysis consisted of descriptions of collective and individual characteristics of the activities. The quantitative data consisted of codes for engagement in activity, role in turn-taking and communicative mode, function and effectiveness.

Participants and Settings

The four children participating in the study were chosen according to the following inclusion criteria: (a) being 5–7 years old and having a diagnosis within the autism spectrum; (b) having little or no functional speech; and (c) having families and clinical staff workers who were positive about playing an active role in the intervention. The children's names are replaced by pseudonyms in the descriptions below. The settings of the study consisted of activities at each of the children's homes. The activities were chosen by the families and staff members in discussions with the research leader. The activities chosen were considered to be communicatively motivating or meaningful to the children and also possible to videotape, resulting in somewhat different activities for the different children. Basic data concerning the participants, settings and SGDs are presented in table 1.

James

James was diagnosed with autism according to the ICD 10 (WHO, 1993) and mild mental retardation, assessed with the Griffiths Developmental Scales (Griffiths, 1970). He was seven and a half years old when the study started and eight years and four months old when the final observations were made. James attended a special school for children with autistic disorders, situated in his hometown. At the start of the study he had only limited speech consisting of approximately ten words, most of which he had learned by imitating a small SGD (ChatBox).[1] This SGD was provided by the local rehabilitation team when he was six years old. He was very interested in this device but did not understand how to use it for spontaneous communication. James's understanding of spoken words was judged to be

Andy

Andy had a diagnosis of unspecified pervasive developmental disorder according to the ICD 10 (WHO, 1993) and DSM-IV (APA, 2000). He was also diagnosed with a Hyperactivity Syndrome according to the ICD 10 (WHO, 1993). He was five and a half years old when the study started. Andy mainly expressed himself in one-word utterances and through physical manipulation of things and people. His speech language pathologist's opinion was that he had a verbal dyspraxia, which affected his speech and made him hard to understand, sometimes even for his parents. He also had difficulties regulating his voice and often spoke very loudly, almost shouting. Andy was placed in a preschool group for children with autism. The family's choice of activities comprised mealtime and 'sharing experiences of the preschool day'.

Intervention Material and Procedures

The research leader held meetings in the homes of the families in which the parents and staff from the local rehabilitation teams took part. Problems and resources related to different activities were discussed and formed a basis for choosing activities, designing communication support and determining the goals to achieve. Ben was given a TechTalk,[2] where six of the eight squares were used. Digital photographs represented the chosen vocabulary recorded on the SGD. James, Andy and Leo needed a more extensive vocabulary, so dynamic screen software was chosen: Clicker 3,[3] implemented on a portable touch-screen computer: Winmax.[4] Graphic symbols, chosen from the internal Clicker base and the Picture Communication Symbols (PCS) library (Mayer-Johnson, 1981), were supplemented with digital photos. Speech synthesis (Infovox[5]) served as the main source of speech output, but some digital recordings were also used. James's vocabulary consisted of 115 messages, Leo's of 279 and Andy's of 176. The recorded messages consisted of some short phrases, mainly sentence starters, and while most were single words. Colour-coding was used to indicate grammatical categories and different activities. These three boys had their vocabulary organized on three levels. All parents, except Ben's, received a half-day-course in Clicker 3, where the parents also had an opportunity to discuss the design of their children's applications. The two families who chose story reading as a target activity attended a half-day course on story reading and the use of assistive technology for children with disabilities. Ben's parents were instructed on how to use their SGD in connection with the start of the intervention in their home. All parents received personal guidance on how to use SGDs in daily communication. They were strongly encouraged to use the SGDs themselves to augment their speech and to serve as models for their children, according to the System for Augmenting Language (SAL). With SAL, partners are instructed to integrate the use of the SGD into natural communicative interaction. In the example 'Tommy, let's go OUTSIDE and RIDE your bike', *outside* and *bike* are symbols that are both touched on the SGD and spoken by the partner (Romski and Sevcik, 1996)

day and to talk about the meal itself. The activity structure and procedures were also described; in the case of mealtime, this meant that the child was supposed to sit down at the table, wait for dinner to be served and then eat. The general role configurations were then characterized; in this example, it meant that the parent had the role of caregiver and the child the role of a recipient of care. The artefacts used were specified, in this case dining-room furniture, cutlery, plates, glasses, bowls and pans. The video camera and the SGD were introduced as uncommon artefacts. Finally, the physical and psychological circumstances within the activity were described; in this example, they seemed to be stressful for all families.

The individual influencing background factors included in the analysis were physical and communicative possibilities together with the individual goals, roles and procedures developed within the activity. In the example of mealtime for James, this meant that James, due to his severe phonological difficulties, was dependent upon his parents' attention and physical closeness to be able to make himself understood. Examples of individual goals, roles and procedure for James's mealtime were that both parents were very anxious and busy preparing James's food and had more time to communicate with the boy after the meal was ready. At that time, James's goal was to eat and he was no longer interested in communication. An intervention means that conditions are deliberately changed in some way. In the activity analyses, the term 'modified' is used to describe such changes. In the mealtime example, it would be 'to use the SGD to communicate'. Objects that are typically not used in the activities, such as the SGD, are referred to as 'uncommon artefacts'. The descriptions of the influencing background factors were then related to the influenced quantitative linguistic coding data derived from the video analyses.

Transcription and Coding

Some of the collected video material was first pilot-coded by the research leader according to the Communication Coding Scheme (CCS) (Romski and Sevcik, 1996). This procedure was found to be useful in forming a basis for an expanded coding scheme (Appendix 2) and a detailed manual with operational definitions (Appendix 1). The coder first watched every

Results

Mealtime

Influencing Contextual Background Factors

Collective factors. The major goal and joint purpose of the activity was that the child should have a meal. A subgoal was to share some information about things that had happened during the day and to talk about the meal itself. A modified goal was to video-record the meal for research purposes. This did not seem to change or disturb the activity very much, but on a few occasions the parents commented on or joked about the fact that they were being recorded. The camera was placed next to the dinner table on a tripod and on a few occasions the parents also had to direct the child or his siblings so they could record the activity satisfactorily. During the SGD intervention, two new modified goals emerged: to use the SGD for communication and for play. The main roles in the activity were (a) child as a recipient of care, and (b) adult as caregiver. In two of the families, the child (with a few exceptions) was the only person eating, while the meal recorded in the third family (Andy) was their Sunday dinner at which the whole family sat down at the dinner table together. In the first two families (James, Ben), one or both of the parents stood or sat near the child. In the case of James, his younger sister and brother were often present in the room, and on one occasion his sister was also sitting down and had a snack. In addition to the video camera and the SGD as uncommon artefacts, dining-room furniture, cutlery, plates, glasses, bowls and pans were artefacts that were present and important for the activity. Concerning the psychological circumstances, all three families seemed to experience a certain amount of stress during the activity of eating, which is further described at the individual level.

Individual factors. Given James's limited phonology, even his family was dependent upon situational cues to understand him, which meant that James was dependent on their attention to make himself understood. He mostly used vocalizations to get his parents' attention. During the intervention, period he was able to use the SGD to direct attention and communicate more independently. His parents also used the SGD to communicate with him. James refused to eat at school and was always very hungry when he came home, a situation

toys away. When the SGD was introduced, Andy spent more time at the table and sometimes chose to play with the SGD, occasionally with a more obvious communicative intent. His parents used the SGD to model communication to Andy, which occasionally resulted in interaction between the parents and Andy with the SGD in focus.

Coding Data

Table 2 clearly shows that the rate of all three children's responses compared to initiatives increased during SGD intervention. Since the 'role in turn-taking' is related to communicative function, it was interesting to see that the most uniform change during mealtime was a decrease in 'attention directing' behaviour and an increase in 'imitating', especially for James. In Andy's case, 'commenting' behaviour increased most and for Ben it was the communicative function of 'requesting'. Looking at communicative mode (table 2) the more advanced children (James and Andy) decreased their use of body communication while, in the case of Ben, it was possible to see that SGD use seemed to stimulate almost all communication (except eye contact). When it came to the measures of 'effectiveness in communication' (table 2), a positive trend was seen for all children during SGD use. This was not a group study but several video observations were made of each child in every activity, and that is why we chose to calculate a mean value for the increase in effectiveness for all observations within an activity. The mean increase in 'effectiveness of communication' for the three children observed during the mealtime activity was 11.5%.

Story Reading

Influencing Contextual Background Factors

Collective factors. Two children, James and Leo, were analysed during story reading. In both cases, the joint purpose of the activity was to read some books together. Another goal was to stimulate and train the child's language, communication and knowledge of the world. A modified goal that emerged during SGD intervention was to use the SGD to provide the child with better possibilities to fulfil the former goals. Another modified goal was to video-record the reading sessions for research purposes. In the case of James, the video camera as an uncommon artefact did not seem to disturb the activity unduly. On a few occasions, his father joked and commented on things to his mother, who generally stood behind the camera. In the case of Leo, his parents felt a growing dissatisfaction with being videotaped. During the study period, Leo became more aware of his deviant speech and his parents thought that this caused his growing aversion to being videotaped. The two main roles identified in the activity were the parent as a reader and trainer and the child as a listener and learner. Artefacts used during the activity were books to read and furniture to sit on. During the intervention period, the SGD was introduced as an uncommon artefact. This resulted in some problems since it was more difficult, physically and psychologically, to handle and focus on the book and the SGD simultaneously. The psychological circumstances during story reading were positive and characterized by warmth and social closeness, especially before the intervention.

Individual factors. In this activity, James mainly communicated through vocalizations, gestures and spoken words and most often made himself understood this way. He sat close to his father at a table and had his father's full attention. Language interaction and training was the purpose of the activity and the content of the books structured the activity and the communication. Every book delimited a sub-activity and to a certain extent every spread in the book also constituted a sub-activity. James's father read the text and asked him to answer simple questions, mostly naming objects or actions. The same three books were read in a fixed order at each session. In the last two sessions before intervention and during intervention, it was noticeable that James's engagement was lower. When the SGD was

Table 3. Story reading: mean coding values without (–) and with (+) SGD

Participant	James –SGD	James +SGD	Leo –SGD	Leo +SGD
Contributions (N)	37.3	35.6	140.3	21.0
Degree of engagement	4.2	4.3	4.3	3.7
Role in turn-taking	(%)	(%)	(%)	(%)
Response	63.2	61.2	65.4	84.7
Initiation	36.8	38.8	34.6	15.3
Mode	(%)	(%)	(%)	(%)
Phys. man.	0	0.5	1.4	1.2
Eye contact	7.1	1.6	1.1	2.4
Gesture	15.9	15.5	25.0	9.3
Graphic	0	0.2	0	2.8
SGD+Graphic	0	19.1	-	33.1
Vocalization	12.5	6.6	5.3	4.0
Speech	64.6	56.6	67.2	47.2
Function	(%)	(%)	(%)	(%)
Answering question	0.2	0.7	14.8	31.2
Affirming stmt./com.	1.3	0.9	2.7	4.8
Negating stmt./com.	0	0	0.9	3.2
Attention directing	8.5	3.0	5.0	0
Commenting prev. contr.	5.6	3.0	8.0	11.6
Commenting other	8.9	7.4	16.6	7.9
Requesting	0.2	2.6	2.9	2.1
Asking question	0	0.2	6.4	3.7
Greeting	0	0	0	0
Imitating	22.8	20.9	14.8	6.9
Naming	46.4	55.0	25.9	24.3
Naming action	6.0	6.3	2.0	4.2
Effectiveness	(%)	(%)	(%)	(%)
Effective	56.7	70.7	72.5	83.6
Not clearly effective	6.9	5.8	16.0	9.5
Unsuccessful	36.4	23.5	11.4	6.9

the SGD, and so they had to sit close to each other to be able to see the computer screen and choose from the available vocabulary. In this situation, the SGD seemed to facilitate talk from both a physical and psychological perspective. Before intervention, the children tended to occupy themselves with toys or other nearby objects and wanted to change the subject of conversation to those activities. When the SGD was introduced, they had something concrete and tangible to look at and handle, which was also relevant to the communication aspect of the activity.

Individual factors. Leo was able to use his speech during the 'sharing experiences of the preschool day' activity. When the SGD was introduced, he also had the opportunity to choose phrases and words on the device to answer his father's questions, comment and sometimes spontaneously talk about something that had happened. Before the SGD was introduced, Leo tried to change the activity into playing with his father and acted more in accordance with the role of playmate. His father to a certain degree accepted this, but then returned to the talk activity and his role as an interviewer.

Andy mainly used his speech, vocalizations and gestures to answer questions concerning his day at preschool. According to the statements of his parents and the video-recordings, Andy hardly answered any questions concerning preschool. The same pattern as in Leo's case was seen: Andy tried to engage the parent in play activities instead of 'only talking'. When he got access to the SGD, this behaviour changed somewhat. Now he answered more questions, even though he still spent most of his time talking about his favourite interests.

Coding Data

Table 4 presents the mean coding data before and during intervention for the activity of 'sharing experiences of the preschool day'. The most marked change seen when the SGD was introduced was that the children's 'engagement in activity' increased (table 4). Regarding 'role in turn-taking', the children showed different patterns of exchange during SGD intervention: Andy's 'response' rate increased while Leo's decreased. With respect to communicative function (table 4), both children increased their use of the 'answering question' and 'naming' categories. As in the other activities, 'attention directing' decreased. 'Requesting' also decreased for both children. The category that separated the children during SGD interventions was 'commenting other', which decreased for Andy while it increased for Leo. Looking at communication mode, body communication ('gestures' and 'eye contact') decreased for both children. Finally, it was possible to note that 'communicative effectiveness' increased during SGD use for both children, with a mean percentage of 19.4%, the highest level for all three activities studied.

Discussion

The first question in this study concerns how SGD intervention for children with autistic spectrum disorders influences communication in different activities in the home setting. Looking at the mealtime activity results first, the general change in physical distance seemed to be very important. For James, this meant that his family stayed closer to him when SGD use was introduced as an activity subgoal and that the activity goals were better synchronized for himself and his parents. James did not use the SGD very much by himself, but his family's SGD use stimulated him to imitate the SGD output and to use more communicative forms in general (table 2). For Ben, who had severe communication problems, the introduction of the SGD meant that he had a new means of expression to investigate. He used the SGD to request food but did not manage to find out how the different messages were connected to the different choices of food or drinks, in spite of his mother's effort to modify the activity, by only providing him with small portions in order to give him reason to request more. Maybe he could have learned to discriminate between messages if he had had more

When it comes to ‘sharing experiences of the preschool day’, it was obvious that the SGD provided both children involved with means of expression which they did not have before, when it simply seemed too complicated and uninteresting to sit down and talk about what had happened. When the SGD was introduced, the ‘engagement in activity’ was dramatically increased, which was also the case for the communicative function of ‘answering question’ (table 4). Andy was more responsive and used the functions of ‘negating’ and ‘requesting’ less. Leo, on the other hand, initiated more, being able to ask more questions and making more comments independently. The activity goal of sharing information was simply impossible for the two boys to fulfil without access to the SGD. It is important to remember that normally developing children start to talk about things that are not in their immediate surroundings at the end of their second year (Ninio and Snow, 1996). Even though these two children were older, they had their documented autism spectrum and expressive disorders, which made it difficult, both cognitively and linguistically, for them to communicate outside the here-and-now. It is therefore interesting to see that both children, and especially Leo, were able to do this with access to communication support in the form of a SGD.

The second question addressed in this study was whether it is possible to identify specific and/or general factors in the different activities that are important for SGD intervention. In all three activities, the introduction of the SGD resulted in an increase in communication effectiveness, defined as when the partner’s response praised, repeated, commented on, expanded or answered the participant’s communication. The parents were instructed to use the SGD and model it for their child, which on a general level meant that a new activity goal was introduced: to use the SGD for communication. Considering the children, the SGD, as a new artefact in the activity, caused them and sometimes other family members, to play with it. This was a modified goal in the activities connected to the intervention, but this modified activity goal generally meant that the physical distance between the children and their communication partners decreased; psychologically, a common focus and a basis for communication was introduced. These changes might in turn, at least partly, underlie the second general trend seen in the coding data: a decrease in the use of the communicative function of ‘attention directing’; in other words, the children were already attended to more.

questions and naming objects and actions in the books. Most parents are well acquainted with the story reading activity, which is a great advantage, since it is such an excellent language training activity (Moerk, 1985). But what became clear with these two families was that it was not so easy to adapt to the needs of the child and also include the use of AAC techniques. The instruction in story reading for children with disabilities that was included in the intervention was not sufficient. There also seemed to be a need for more personal feedback, probably by video monitoring, so parents would be able to adapt to and stimulate communication and AAC use in the child and handle all the artefacts involved.

Limitations and Future Directions

The most important limitation on this study is that it only included data from four participants and that data was collected in only three activities. Furthermore, not all the children were observed in all three activities. On these grounds, the research results in this study cannot be generalized to other children with autistic spectrum disorders or to the same activities in the homes of other children. As mentioned in the introduction, there is a great need for research conducted, first, in the homes of children with communication impairments and/or autistic spectrum disorders and, second, on SGD intervention in other activities besides mealtime.

Another limitation is that no follow-up observations were included. This means that many of the positive changes in the activity and communication patterns found might be novelty effects, which may have faded out in time. Another important factor in this respect is the parents' engagement in the intervention. Their investment of energy and time might, deliberately or not, influence their children's behaviour and the results of the study. The lack of longitudinal research is of the utmost importance in all these respects. Hardly any research has been done on the long-term effects of AAC intervention regardless of the type of communication impairment or the type of AAC concerned.

The importance of instructing and supporting the parents was noted at several points in this study. The amount of parental instruction, especially in basic communication development

intervention. There is definitely a need for more parental instruction in communication development and training. Another important finding is that there were many problems during the mealtime activity in the homes of these families that should be taken into consideration when decisions are made regarding home-based intervention. Even though most of the evidence in the field of SGD intervention comes from research on the mealtime activity, it should not be taken for granted that this is the best activity to choose for intervention in the home environment. This finding points to two concluding remarks: (1) that the goals and communicative roles in the activities chosen need to be discussed with the families when planning an AAC intervention in the home; and finally (2) that there is a real need for specific research into communication intervention conducted in the homes of children with autistic spectrum disorders.

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STUDY III

Abstract

The communication of four children with autistic spectrum disorders, who used a speech-generating device (SGD) in one or two selected activities in their home environment, was investigated. The children were between five and seven years of age. The conversational topics introduced by the children and their parents were analyzed. The introduction of the SGD increased conversational interaction, as measured by topic length, for all children in five of the six activities studied. The analysis of topics showed that conversation within the "ongoing activity" increased and that the irrelevant speech used by the two more verbal children was reduced with access to the SGD.

year-old boy was able to successfully transfer to his home setting his ability to use an SGD to request preferred objects. One study measured both children's and classroom staff's communicative behaviors (Schepis et al., 1998). In this study, four children (3 to 5 years of age) with autism and little or no functional speech were taught to use an SGD in two classroom routines (snack and play). Natural teaching procedures were used to focus on communicative behaviors that were of immediate functional utility (Schepis et al., 1998). All children in the study increased their number of communicative behaviors using SGDs. The results also showed that the children used the SGDs for a variety of different messages (requests, *yes* and *no* responses, statements and social comments). These were judged to be contextually appropriate. During the SGD and natural teaching conditions, the number of staff communicative behaviors directed to a specific child increased markedly. The authors speculated that the increase in staff interaction was partly due to the training, aimed at promoting communicative behaviors, and partly connected to the fact that the children could be more easily understood when they used their SGDs (Schepis et al., 1998).

In a study by Sigafoos et al. (2003) the specific role of speech output was evaluated in three individuals with autism across two conditions of SGD use: speech output versus no speech output. It was concluded that the device was used for functional communication, that the children appeared to be attentive to the speech output and that the SGD seemed to stimulate speech. Partner communication was not studied but the authors' opinion was that speech output is potentially more appropriate and effective than prelinguistic acts since it provides a signal to the listener that is similar to natural speech (Sigafoos et al., 2003).

The Effect of Autistic spectrum disorders on Interaction and Conversational Topics

In the literature describing communication and interaction problems in children with autism, communicative content is an important issue. The problems children with autism have in representing the perceptions, feelings and thoughts of other persons, in other words, a "theory of mind," cause many of their difficulties in sharing content and conversational topics in communication with other people (Twatchman-Cullen, 2000). Problems within the

or failure to expand the ongoing topic. In a case study of a child with pragmatic problems, the qualitative method of conversational analysis (CA) was applied (Radford & Tarplee, 2000). It was found that the 10-year-old boy was able to use question-sequences to initiate and maintain conversational topics but that this narrow style of topicalization led to difficulties in collaborating with his conversational partners.

A topic analysis was developed to investigate the conversational content of natural interactions between caregivers and children during the mealtime activity in their homes (Ferm, 2006; Ferm, Ahlsén, & Björck-Åkesson, 2004). The participants in this study were one 6-year-old child with complex communication needs (cerebral palsy) and her caregiver and one matched typically developing child and parent. Communication involving the child with cerebral palsy mostly concerned immediate mealtime issues, while, in contrast, the child and parent in the comparison dyad conversed about a variety of topics that extended beyond the present. The topic analysis developed and applied by Ferm and colleagues (Ferm, 2006; Ferm et al., 2004) was used in the present study.

Aims and Research Questions

In this study, an analysis of conversational topics was carried out in selected activities in the homes of four children with Autistic spectrum disorders. It was expected that the introduction of an SGD with a dedicated vocabulary and supporting pictures would facilitate the discussion of relevant conversational topics and increase the number of communicative contributions within a topic segment, that is, topic length. These changes were expected to contribute positively to interactions between the children with Autistic spectrum disorders and their parents. The following questions were addressed: (1) Does the pattern of conversational topics being used change with respect to types, numbers and initiators during the SGD intervention? (2) How is topic length affected by the introduction of an SGD in different activities in the home setting?

physical manipulation of items and people, he managed to make himself understood in routine situations at home, but had difficulties in other situations and among people who did not know him well. The activities selected by the family for the intervention was lunch time and story reading.

Ben.

Ben was diagnosed with autism and moderate mental retardation, according to the ICD 10 (WHO, 1993). He was seven years old when the study started. The language situation in Ben's home was complex. Since his mother was a native speaker of French and the family had lived in several European countries, French, Swedish, German and English had all been used at home. At the time of the study, Ben's mother mainly spoke French to him, whilst the rest of the family and society at large spoke Swedish. Ben's interest in and understanding of speech and auditory input was judged to be higher than that for pictures and visual information. He demonstrated some understanding of spoken words in both French and Swedish but had no functional speech output. He used his voice, sounds and physical manipulation of things and people to communicate. Ben went to a special school for children with autism. He had had no earlier experience of SGDs. The activity selected by the family for intervention was mealtime.

Leo

Leo's diagnosis was pervasive developmental disorder—not otherwise specified, according to the ICD 10 (WHO, 1993) and DSM-IV (APA, 2000). At the start of the study, he was five years old. At that time, he expressed himself in up to two- or three-word sentences but was extremely hard to understand due to phonological deficits, judged by his speech language pathologist to be related to problems with oral praxis. He was quite communicative but had a tendency to give up when he could not make himself understood. Leo was placed in the local preschool group with part-time individual assistance. He had had no earlier experience of SGDs. The activity selected by the family for intervention was story reading.

Andy

Andy had a diagnosis of pervasive developmental disorder—not otherwise specified, according to the ICD 10 (WHO, 1993) and DSM-IV (APA, 2000). He was also diagnosed with a Hyperactivity Syndrome according to the ICD 10 (WHO, 1993). He was five and a

assistive technology for children with disabilities. Ben's parents were instructed in how to use their SGD in connection with the beginning of the intervention in their home. All parents received personal guidance on how to use SGDs in daily communication. They were especially encouraged to use the SGDs themselves in appropriate communication situations to augment their speech and serve as a model for their child, according to the System for Augmenting Language (SAL) (Romski & Sevcik, 1996). In the example "Tommy, let's go OUTSIDE and ride your BIKE," *outside* and *bike* were symbols that were both touched on the SGD and spoken by the partner (Romski & Sevcik, 1996). All instructions and guidance to the families concerning the SGD intervention were given by the research leader.

Research Design and Procedures

A single-subject design of the type AB (Hegde, 1994) including four children within the autistic spectrum, was used to study conversational topics before and during SGD intervention in the home. Video analysis was used to assess the types of topics, number of segments and contributions, and initiators of topic segments.

Video recordings were made by the parents themselves to minimize disturbance in the children's natural environments. Each family was supplied with a VHS camera placed on a tripod. The parents were instructed to videotape the chosen activities once a week, for approximately 15 minutes on at least four occasions before the intervention started and to do the same during the intervention. All four families preferred to start the intervention for one activity at a time. When the software applications and the baseline recordings were ready, the SGDs were introduced in the activities, which were kept as natural and consistent as possible, apart from the instruction to the parents to also use the SGD to model and augment their communication. Parents were told to start the recordings as soon as possible (after they had become familiar with the SGD).

mean topic length for each observation occasion was calculated and presented across two activities for two of the participants and one activity for the other two participants, to answer the second research question. Discourse excerpts were selected to further illustrate the impact of SGD intervention on topic use and interaction between the four children and their parents; these are presented below.

Interobserver Agreement

Randomly selected sections of 10% of the video recordings were analyzed by another observer to check for interobserver agreement. This second observer was the local speech language pathologist for two of the participants. Her knowledge was judged to be essential, since the communication of these two boys was almost impossible for a naive observer to code. The second observer was trained in the coding procedure for approximately four hours. Interobserver agreement was calculated using the formula: agreements / (agreements + disagreements) x 100. The interobserver agreement was 93% for topic determination and 100% for coding of the initiator of a topic segment.

Results

Topic Analysis

Table 2 shows the results of the topic analysis. The amount of recorded and analyzed data differs somewhat between the children, the activities and the phases of intervention (table 1). Topic length is therefore the only available time-independent measure presented in table 2, since it consists of the mean number of contributions per topic segment. The most general trend seen in table 2 was that the total number of topic segments decreased during the intervention. This was seen for all participants during all activities (regardless of the differences in the amount of analyzed data). Both parents and children initiated fewer topic segments while the SGD was being used (table 2). This decrease also affected the topic length measure since the total number of contributions in most activities stayed at the same

Table 2. Results of topic analysis for all participants and activities without (–) SGD and with (+) SGD.

Participant	Activity	Topic	No. of topic segments (s)		No. of contributions (c)		Topic length (c/s)		Initiative			
			– SGD	+SGD	– SGD	+SGD	–SGD	+SGD	– SGD		+SGD	
									Parent	Child	Parent	Child
James	Mealtime	Ongoing activity	62	41	337	502	5.4	12.2	41	21	28	13
		Unclear	18	15	77	71	4.3	4.7	–	18	–	15
		School	4	0	18	–	4.5	–	4	–	–	–
		Tired	–	10	–	40	–	4	–	–	–	10
		Tired eyes	–	1	–	2	–	2	–	–	1	–
		Total	84	67	492	625	5.9	9.3	45	39	29	38
	Story reading	Ongoing activity	275	236	1179	1217	4.3	5.2	170	105	147	90
		Total	275	236	1179	1217	4.3	5.2	170	105	147	90
Ben	Mealtime	Ongoing activity	43	13	163	149	3.8	11.5	42	1	4	9
		Video camera	3	–	15	–	5	–	3	–	–	–
		Unclear	3	–	18	–	6	–	–	3	–	–
		Total	49	13	196	149	4.7	11.5	45	4	4	9
Leo	Sharing experiences	Ongoing activity	97	47	660	703	5.6	14.6	90	7	31	16
		Unclear	5	–	10	–	2	–	–	5	–	–
		Other play activities	37	2	317	130	9.3	65	21	16	–	2
		Physical contact	4	–	18	–	4.5	–	1	3	–	–
		Visit grandpa	–	4	–	13	–	4.3	–	–	–	4
		Leaflet	4	2	44	31	11	15.5	1	3	–	2
		Dinner	–	1	–	12	–	12	–	–	–	1
		Spider	–	1	–	17	–	17	–	–	–	1
		Clock	–	1	–	76	–	76	–	–	–	1
		Objects in pocket	4	–	26	–	6.5	–	–	4	–	–

Example 1. "Sharing experience of the preschool day" for Leo, without SGD, observation occasion 2. Speech output from the SGD is written in capital letters. Translations into English are indicated in italics. Every new topic segment is labeled and presented in the left margin of the transcriptions.

Ongoing activity:	Parent: Vad har du gjort på dagis idag då?
	What happened at preschool today?
	Leo: Hm
Ongoing activity:	Parent: Leo, titta på pappa!
	Leo, look at daddy!
	Leo: N
Ongoing activity:	Parent: Vad har du gjort på dagis idag då?
	What happened at preschool today?
	Leo: N
Ongoing activity:	Parent: Har ni haft nallefest?
	Did you have a teddy-bear party?
	Leo: N
	Parent: Va har ni gjort med dom då?
	What did you do with them then?
	Parent: Va har ni gjort?
	What did you do?
	Parent: Har ni haft nallefest?
	Did you have a teddy-bear party?
	Leo: N
Play with object:	Leo: De, de, de, de
	There, there, there, there

Example 2. "Sharing experience of the preschool day" for Leo, with SGD, observation occasion 3.

Ongoing activity:	Parent: Har ni varit ute nånting idag?
	Have you been outdoors today?
	Leo: VARIT UTE
	BEEN OUTDOORS
	Parent: Där var den

the SGD. The father, however, regained the initiative in reading. Example 3 below contains an excerpt from this observation occasion.

Example 3. Story reading for James, with SGD, observation 1.

Ongoing activity: Parent: Här sitter Sune

Here Sune sits

Ongoing activity: James: POJKE, kä [speech=pojke]

BOY, kä [speech=boy]

Parent: Han e pojke, ja

He's a boy, yes

James: SITTER tä [speech=sitter]

SITS tä [speech=sits]

Ongoing activity: Parent: Han sitter, på soffan, och funderar var Putte är. Putte är Sunes katt.

He sits, on the sofa, thinking of where to find Putte. Putte is Sune's cat.

James: tä [speech=Putte]

tä [speech=Putte]

Ongoing activity: James: GÅR, gå [speech=goes]

WALKS, gå [speech=walks]

Ongoing activity: Parent:så går han ut genom dörren. Sune går ut för att leta efter Putte.

Then he walks out through the door. Sune is going out to look for Putte.

Ongoing activity: James: TRAPPA

STEPS

Ongoing activity: Parent: Putte brukar ligga under trappan

Putte usually lies under the steps

James: pa [speech=steps]

pa [speech=steps]

Parent: trappan

the steps

Parent: TRAPPA, trappan [speech]

Unclear: James: nan [vocalization]

Ongoing activity: Parent: Är du hungrig James? Vi väntar på att din mat skall bli varm.

Are you hungry, James? We're waiting for your food to get warm.

James: e [vocalization]

Unclear: James: je [vocalization]

Parent:m

Ongoing activity: Parent: Du måste dricka lite mjölk också.

You have to drink some milk as well.

James: n

James: hawking + glottal sound + an n uju de

James: eh [vocalization]

Ongoing activity: Parent: Så, här är mjölken.

So, here is the milk.

James: ehe [vocalization]

James: keje [vocalization]

Parent: m

Example 5. Mealtime with SGD, observation occasion 1:

Ongoing activity: James: dott [speech=gott] + [looks at picture on SGD]

good

James: ÄCKLIGT + teti [speech imitation=äckligt] + ä + [eye contact]

DISGUSTING + teti [speech imitation=disgusting] + ä + [eye contact]

Parent: E de äckligt? sa du de? Jag tror att de e, GOTT.

Is it disgusting? Did you say so? I think it is, GOOD.

James: Dott speech, imitation= gott] + [looks at adult], gott, gott, gott

[repeats] dott [speech imitation= good] + [looks at adult], good, good, good [repeats]

Parent: GOTT, m

GOOD, mm

James: gott [speech, imitation]

Figure 1. James: Topic segment length (mean number of contributions/topic segment during an observation occasion) before SGD-use and during SGD-use. Dotted line=mean topic segment for all observation occasions before/during SGD

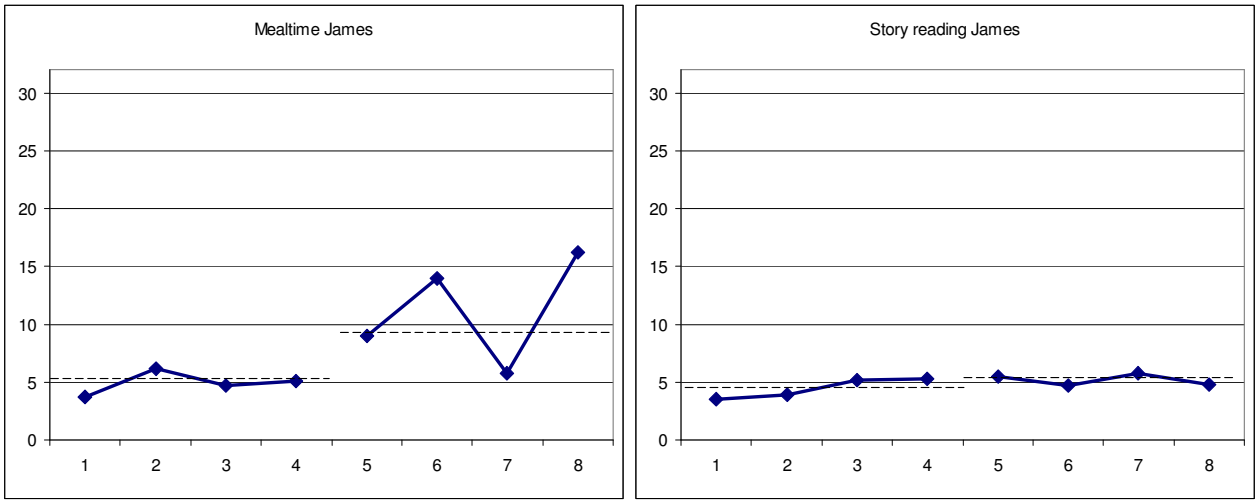
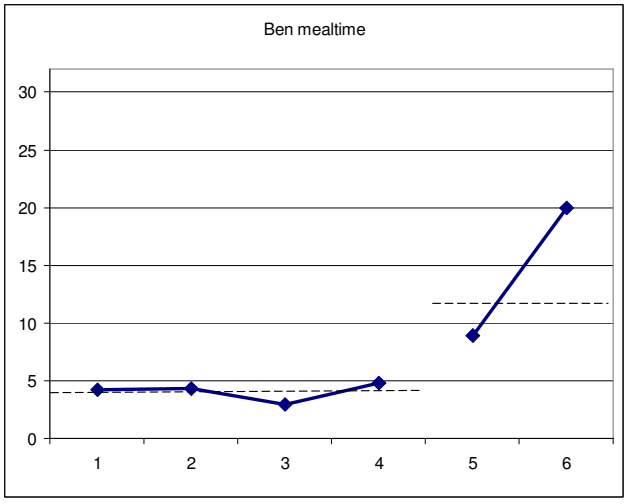


Figure 2. Ben: Topic segment length (mean number of contributions/topic segment during an observation occasion) before SGD-use and during SGD-use. Dotted line=mean topic segment for all observation occasions before/during SGD.



Discussion

Conversational Topics and SGD Use

Our first research question concerned patterns of topic use during the children's different activities and whether any changes were seen when the SGD was introduced. The expectation was that the vocabulary, pictures and topics available and visible on the SGD would decrease irrelevant speech and increase the amount of contributions within the topic of the ongoing activity. This also proved true for all four participants in this study. The proportion of communicative contributions on topics unrelated to the ongoing activity decreased in all activities when the SGD was introduced (table 2). Looking first at "Andy mealtime," Andy's use of topics unrelated to the ongoing activity, preferably "Action Man," his favorite toy and special interest, decreased when the SGD was introduced (table 2). This was seen as very positive and was a relief to his parents, due to the intensity of his "Action Man communication." This might have been a novelty effect; unfortunately, we cannot be sure of this since no follow-up observations were done. The same pattern was, however, also seen during the "sharing experience" activity where the "Action Man" topic was not raised at all during the SGD intervention.

Leo did not have the same strong drive to talk about a certain special interest as Andy did. He was more apt to manipulate objects (usually toys) in his immediate surroundings and communicate about them. When the SGD was introduced, the use of "play topics" decreased (table 2). Leo also became more likely to initiate topic segments about the ongoing activity during the intervention (table 2, examples 1 and 2). The tendency to initiate topic segments about the ongoing activity was also seen for Andy during "sharing experiences." The studies of topic use and conversation patterns in children with autism reported on above all included speaking children, almost all of whom were older than the children in this study (Capps et al., 1998; Hale & Tager-Flusberg, 2005; Tager-Flusberg & Anderson, 1991). The difficulties related to topic use described in these studies such as the use of non-contingent topics, lack of relevant contributions, and failure to expand the ongoing topic, are to a certain extent

SGDs and Interaction in Different Activities in the Home Environment

The second question addressed in this study was whether interactions between children with Autistic spectrum disorders and their parents were affected by the introduction of an SGD in different activities in the home setting. The dependent measure of interaction was topic length, including contributions made by the child and the parent. It was expected that access to a relevant and easily accessible vocabulary on the SGD would increase topic length. This was seen in five out of the six activities studied. The overall increase was not very large, since there was a lot of variation among the children, the activities and sometimes also between the baseline and intervention phases of a specific activity (figures 1 to 4). The small number of probes included in most of the phases of this study is therefore a notable weakness.

Nonetheless, access to the SGD clearly influenced topic length in some activities. The most evident change was seen during the "sharing experience of the preschool day" activity for both Leo (figure 3, examples 1 and 2) and Andy (figure 4). The access to the vocabulary and pictures related to the preschool seemed to facilitate attention to and interaction about a topic not otherwise available to the child. During the baseline period, these children instead tended to communicate about favorite toys and activities while their parents kept on asking questions about their day at preschool (table 2, examples 1 and 2). The few topic segments of considerable length during the baseline phases mostly involved topics initiated by the children that were not connected to their day at preschool. The results for Ben during mealtime also showed a clear increase in topic length when he got access to the SGD (figure 2). The SGD probably gave Ben and his mother a means of immediate interaction and a tool to explore language and communication. The results for James during mealtime were similar to Ben's, as was the observed interaction pattern during the activity: the SGD became a common focus of interest for the child and the parent and a tool to collaboratively use to explore language and communication (figure 1 and examples 4 and 5). James's results in the story reading activity before and during the intervention only showed a minimal increase in topic length, as noted in figure 1. The impression this activity gave was that the SGD did not

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STUDY IV

Abstract

In this case study, a seven-year-old boy diagnosed with autism and mental retardation was supplied with a speech-generating device (SGD) in two activities at home and one activity at school. Activity Based Communication Analysis (ACA) was used as the basis for discussing communicative behaviours in video recordings made before and during SGD intervention. The coded communicative behaviours were engagement in activity, role in turn-taking and communicative form, function and effectiveness. Conversational topics were also analysed. Activity characteristics seemed important for the outcome. In the two more structured activities (story reading at home and morning circle at school), the child could use the SGD to communicate within the given frames, but interaction, as measured by topic length, was only slightly changed. During mealtime at home, topic length increased and the instruction to the parents to also use the SGD resulted in positive changes in this activity. ACA highlighted some important aspects for SGD intervention, such as communicative needs and vocabulary.

make social comments in two classroom routines. A retrospective study that attempted to evaluate the use of different AAC tools was done on children in British Columbia, Canada, over a five-year period (Mirenda et al., 2000). Of the 58 children in this study who were supplied with SGDs, 53% were rated as successful or very successful, while 33% had limited or some success. The results showed no evidence of a relationship between cognitive ability and successful SGD use. In a detailed case study, Light et al. (Light et al., 1998) suggested that multimodal AAC offers significant potential as a means to augment both expression and comprehension in many individuals with autism. The authors pointed out that careful assessment is required to determine the individual's skills and needs, coupled with support from facilitators to ensure that the person is given the opportunity to communicate effectively. A case study involving an adolescent with developmental disability and autistic symptoms generated similar conclusions (Sigafoos and Drasgow, 2001).

In another study, the effects of speech output on the maintenance of requesting and frequency of vocalizations were evaluated (Sigafoos et al., 2003). The children were first taught to request access to preferred objects using an SGD. The three children were then compared across two conditions: speech output on or off. There were no major differences between the two conditions, suggesting that access to the preferred object was the target, not the SGD per se. One of the children began to speak in single words, suggesting that in some cases SGDs may facilitate speech. Partner communication was not studied, but the authors' often-stated opinion was that speech output has the potential to be more appropriate and effective than prelinguistic acts since it provides a signal to the listener that is similar to natural speech (Sigafoos et al., 2003). A somewhat different speech output application was used in a study where five children with autism were trained with computer animations of daily activities (Hetzroni and Tannous, 2004). Communicative interaction was demonstrated and prompted in different ways. The results showed that the children were able to transfer their acquired knowledge to the natural environment.

activities (Allwood, 2000; (Beukelman and Mirenda, 2005; Ninio and Snow, 1996). One framework designed to study and describe this phenomenon is Activity Based Communication Analysis (ACA), which is primarily based on the ideas of Wittgenstein (Allwood, 2000). ACA has also been adapted to and used in clinical research (Ahlsén, 1995; Ferm, 2006; Ferm et al., 2004; Saldert, 2006). Context is shown to play a major role in the production and understanding of meaning, and activity is seen as the basic organizing contextual aspect of social reality that influences interaction (Allwood, 2000). In this method, collective and individual factors that influence interactions during an activity are qualitatively analysed to serve as a frame of reference for the interpretation and discussion of the linguistic factors in question. The advantage of ACA is that it delineates different factors of importance for understanding communicative behaviour in a specific activity.

Research questions

In this study, the communication of a boy with autism and mental retardation was investigated when he was supplied with a speech-generating device at home and at school. ACA (Allwood, 2000) was used as a framework to specify important properties of the activities and to compare the differences in linguistic measures among the various activities and settings. Coding data on the child's communicative contributions and conversational topic maintenance by both the child and the parent were analysed. Since very little research has been done in the home setting, it was considered important to discuss the similarities and differences between the activities in the school and home environments. The following questions were addressed:

1. How is communication in different activities at home and at school affected by the introduction of an SGD, as measured by (a) engagement in activity, role in turn-taking, and communicative form, function and effectiveness, and (b) conversational topics?

passive vocabulary with the Peabody Picture Vocabulary Test (Dunn and Dunn, 1981) was carried out. An interview with his parents using the complete version of the Vineland Adaptive Behavior Scales (VABS, Sparrow et al., 1984) showed that James's expressive level was equivalent to a developmental age of one year and eight months and his receptive level to the age of two years and seven months. His autism percentile (Carter et al., 1998) within the communication domain was 65. The percentile within the domain of daily living skills reached 75, socialization was 65 and motor skills 85.

Intervention

In this study, a family-centred intervention model incorporating collaborative problem-solving was used (Björck-Åkesson et al., 1996; Zachrisson et al., 2002). This model is adapted to the International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization (2001). Problems and their explanations are formulated and available resources established in relation to the different components of the ICF: body structure and function, activity and participation, and contextual factors. This problem grounding, as well as the decision-making concerning which goals and methods to select, took place during team discussions, where the views of the parents played a central role.

The research leader organized meetings in which the parents, teacher and staff from the local rehabilitation teams took part. The intervention at school took place the year after the intervention at home. The class teacher and the school speech-language therapist took part in the meetings that were held at school. During the intervention planning meetings, problems and resources related to different activities, as perceived by the parents and school staff, were discussed. Together with the research requirements, these formed a basis for the selection of activities and goals and the design of the SGD application. The activities selected for intervention were mealtime and story reading at home, and morning circle at school. The parents' expectations were that if James had access to an SGD at meals, he would be able to make more

Experimental design, material and procedures

A single-subject case study with AB design across settings (Hegde, 1994) was used to investigate the impact of the communication support in the two activities at home and one at school. Video analysis was used to code communicative effectiveness, role in turn-taking, communicative mode, function and degree of engagement in activity. Conversational topics were also analysed with respect to type of topic, number of topic segments and contributions and initiator of topic segment.

Video recordings were made by the parents and the teacher themselves to minimize disturbance in the child's natural environments. They were supplied with a VHS camera on a tripod and instructed to videotape the chosen activities once a week, for approximately 15 minutes on at least four occasions before the intervention started and to do the same during the intervention. The family wished to start the intervention with one activity at a time. When the software applications and the baseline recordings were ready, the SGD was introduced into the activities, which were kept as natural and consistent as possible, apart from the instructions to the parents and school staff to also use the SGD to model and augment their communication. The parents and the teacher were told to start the recordings as soon as possible (after they had some acquaintance with the SGD).

Activity Based Communication Analysis

Data were analysed according to the principles of ACA (Ahlsén, 1995; Allwood, 2000; Ferm, 2006), a method that combines qualitative and quantitative data. Qualitative descriptions of the characteristics of the activity and the individuals taking part in it serve as a basis for analysis and discussion of linguistic data, most often of a quantitative nature.

The factors that influenced the activity were described from both a collective and an individual perspective. The analysis of the collective factors included, first, a specification of the main purpose and subgoal(s) of the activity; for example, in the mealtime activity, the main purpose was that the child should have a meal and the

procedure was found to be useful in forming a basis for an expanded coding scheme (appendix 2) and a detailed manual with operational definitions (appendix 1). A broad transcription of the boy's communicative contributions was made and then coded along five different dimensions: degree of engagement in activity, role in turn-taking, mode, communicative function and effectiveness (ability to make oneself understood). The amount of coded and transcribed video material used in this study totalled 6 hours collected on 24 occasions.

Topic analysis

The topic analysis methodology was developed by Ferm (Ferm, 2006; Ferm et al., 2004), influenced by the work of Brinton and Fujiki (1984), Keenan and Schieffelin (1976), and Mentis and Prutting (1991). The analysis followed four steps: (1) Each video recording was sequentially analysed for topic segments. A topic segment was defined as a contribution or several contributions in succession that had a common main focus (topic). Words, vocalizations, word approximations and body communication that referred to the same action, activity, person, object or idea were considered to have the same focus and were regarded to belong to one and the same topic segment. (2) Each topic segment was labelled with regard to its main focus (e.g., event at school), which thereafter constituted the topic of that topic segment. All topic segments with issues related to the observed activity (e.g., mealtime) were defined and labelled as 'ongoing activity'. The ongoing activity topic included (a) everything that had to do with the activity structure and practical goals and (b) the child's or caregiver's communication and/or behaviour in relation to the implementation of the activity. (3) Each topic segment was specified for length with regard to the number of contributions involved from the initiation of the topic segment until its end. (4) Each topic segment was coded with regard to whether it had been initiated by the child or the parent.

instructed to use the SGDs according to their judgement of appropriateness in the situation and consequently the number of SGD activations varied in the different activities. The SAL technique was used in each activity, and the interobserver agreement was 87%.

Results

Mealtime

Influencing contextual background factors

Collective factors. The major goal and joint purpose of the activity was that the child should have a meal. A subgoal was to share some information about things that had happened during the day and to talk about the meal itself. A modified goal was to video-record the meal for research purposes. This did not seem to change or disturb the activity. During the SGD intervention, two new modified goals emerged: to use the SGD for communication and for play. The main roles in the activity were (a) the child as a recipient of care and (b) the adult as caregiver. The meal studied was James's lunch, which was served upon his return from school. The structure of the activity was that James first choose his food and then assisted his parents with some cooking tasks, for example pouring water in the pan. After this, he assisted his parents in laying the table which after he sat down at the table and waited for his food to be ready. One or both of the parents stood or sat near the child. His younger sister and brother were often present in the room, and on two occasions his sister also sat down and had a snack. In addition to the video camera and the SGD as uncommon artefacts, dining-room furniture, cutlery, plates, glasses, bowls and pans were artefacts that were present and important for the activity. Concerning the psychological circumstances, there seemed to be a certain amount of stress during the mealtime, because James was so hungry.

Table 1. Mean coding values for James without (–) and with (+) the SGD.

Activity	Mealtime		Story reading		Morning circle	
SGD –/+	–	+	–	+	–	+
Engagement	5.0	4.5	4.2	4.3	2.0	3.5
Contributions (n)	49.8	52.8	37.3	35.6	30.0	39.8
Role in turn-taking (%)						
Response	37.2	54.5	63.2	61.2	67.5	87.4
Initiation	62.8	45.5	36.8	38.8	32.5	12.6
Mode (%)						
Phys. Man.	1.1	0.7	0	0.5	7.5	0.5
Eye contact	16.8	29.9	7.1	1.6	10.1	12.7
Gesture	5.0	1.3	15.9	15.5	19.6	3.8
Graphic	0	0	0	0.2	8.0	0
SGD + Graphic	0	10.1	0	19.1	–	26.8
Vocalization	53.8	21.1	12.5	6.6	11.1	4.2
Speech	23.3	36.9	64.6	56.6	43.7	52.1
Function (%)						
Answering question	7.8	3.3	0.2	0.7	7.5	15.7
Affirm. stmt./com.	7.3	13.1	1.3	0.9	5.0	3.1
Negating stmt./com.	0.8	2.0	0	0	0.8	0.6
Attention directing	45.0	23.7	8.5	3.0	14.2	6.9
Comment prev. contr.	12.9	16.1	5.6	3.0	3.3	0
Comment other	23.5	18.8	8.9	7.4	18.3	0
Requesting	1.6	1.8	0.2	2.6	4.2	1.3
Asking question	0.4	0	0	0.2	0.8	0
Greeting	0	0	0	0	2.5	0
Imitating	0.8	21.2	22.8	20.9	38.3	44.0
Naming	0	0	46.4	55.0	5.0	28.3
Naming action	0	0	6.0	6.3	0	0
Effectiveness (%)						
Effective	60.5	73.7	56.7	70.7	50.8	49.1
Not clearly effective	0	2.0	6.9	5.8	34.2	42.8
Unsuccessful	39.5	24.3	36.4	23.5	15.0	8.2

Topic analysis

Topic length increased as a result of a decrease in the number of topic segments while the number of contributions increased (table 2). The distribution of initiated topic segments also changed somewhat, so that James initiated most of the topic segments during the intervention.

Story reading

Influencing contextual background factors

Collective factors. The joint purpose of the activity was to read some books together. Another goal was to stimulate and train the child's language, communication and knowledge of the world. A modified goal that emerged during the SGD intervention was to use the SGD to give the child with better possibilities of fulfilling the former goals. Another modified goal was to video-record the reading sessions for research purposes. The video camera as an uncommon artefact did not seem to disturb the activity very much. On a few occasions, the father joked and commented on things to the mother, who usually stood behind the camera. The two main roles identified in the activity were the parent as a reader and trainer and the child as a listener and learner. The structure of the activity was high. The books served as a basis for this structure and communication. Every book delimited a subactivity and, to a certain extent, every spread in the book also constituted a subactivity. The same three books were read in the same order during all sessions. James's father read the text and asked the boy to answer simple questions, mostly naming objects or actions. Artefacts used during the activity were books to read and furniture to sit on. During the intervention period, the SGD was introduced as an uncommon artefact. This did result in some problems since it was more difficult to handle and focus on the book and the SGD simultaneously. James sat at a table close to his father. The psychological circumstances during story reading were mainly positive and characterized by warmth and social closeness.

Individual factors. The activity goal of reading the book together, as stated above, could be applied to the child as well. The goal concerning language training was not of any interest to James and consequently the role of learner related to this goal was not obvious to or chosen by the child. James's possibility of taking on another role was very limited considering his restricted communicative abilities. Within the given roles and procedures, James's possibilities of communicating were comparatively good with

the students in language and communication. The teacher explained that during the year of the study she had mainly chosen tasks that met the needs of the more advanced students in her group. A modified goal was to video-record the morning circle for research purposes. The video camera did not seem to disturb the activity. Another modified goal during the intervention phase was to use the SGD to augment James's ability to participate in the activity. The structure and procedures during the activity were fixed. The teacher planned the morning circle and a schedule put up on the blackboard showed the different subactivities. During the study period, the morning circle followed the same routine: light a candle and listen to music, go through the early morning schedule and name the morning circle activity, tell the others how one had travelled to school, name the day of the week, name absent/present persons, write one's name on the whiteboard, count boys and girls, choose and sing songs, have a biscuit, go through the rest of the schedule for the day including checking the lunch for the day. The only subactivity that was changed during the period was the song session, which was changed to selecting and naming objects during the last two intervention sessions.

Interaction basically followed the same procedure during each morning circle in that the teacher introduced a subactivity/topic and then asked the group questions, most often to one student at the time. The roles identified were teacher, student and assistant. The teacher introduced and led all subactivities and conversational topics. The students answered the questions and performed the tasks given by the teacher. The assistants played a very passive role. They actively took part in the subactivity of naming present and absent persons, and in the subactivity of telling how they arrived at school the specific day, for instance, on foot, by bicycle or in a taxi. During these subactivities, their role also was to model how to answer the teacher's questions. During the remaining subactivities, their role was to support the students in their participation in the activities. Artefacts used during the activity were a table, chairs and a whiteboard with pens and magnets. Different sets of photos/pictures with text were used to symbolize different persons, weekdays, songs, objects, activities and

use of body communication, that is, physical manipulation, gestures and vocalizations, was seen during use (table 1). Looking at communicative function, James's use of 'answering questions' and 'naming' increased while 'attention directing behaviour' and 'commenting other' decreased during SGD use. Regarding 'communicative effectiveness', the share of unsuccessful contributions decreased during SGD use, but the amount of effective contributions did not increase. Instead, a minor decrease was seen and the category of 'not clearly effective' increased with access to the SGD (table 1).

Topic analysis

The result of the topic analysis of morning circle showed that James's use of topics outside of the ongoing activity decreased during intervention. Regarding the quantitative measures, there were only small changes, with a minor decrease in topic length during morning circle (table 2).

Discussion

The first question addressed in this study concerned how James's communication in different activities at home and at school was affected by the introduction of an SGD. The mealtime activity in this study was a bit different from most family mealtimes, in that James was usually the only person eating. The fact that he refused to eat the school lunch and was very hungry when he came home was stressful for his parents. The intervention goal formulated by the parents was that James should be able to make more choices concerning food and comment more. The vocabulary was chosen based on these premises. As it turned out, it was while sitting at the table waiting for lunch to be served, that James was motivated to communicate. Before the intervention, he used a lot of vocalizations (table 1) primarily to 'direct attention' (table 1). When the SGD was introduced, the parents more often left the stove and came closer to James because they had been instructed to model SGD use. This resulted in more interaction in that

as the reader and James withdrew to the role of listener/learner. The minimal changes within the topic analysis, with topic length increasing only slightly, might also be due to the structure and strict role patterns. Role in turn-taking consequently did not change notably. Within the responding role, James used the SGD to name and answer questions (table 1). Although James's use of the SGD was limited, his communicative effectiveness increased markedly. The SGD was often easy for his father to attend to and understand, which seems to confirm the ideas expressed by Sigafoos et al. (2003) in their study on the role of speech output.

The activity selected by the school staff was morning circle. The goal was that the SGD should facilitate James's ability to participate in this activity since the teacher was well aware of the problems James had in managing all the verbal demands that were included. The activity analysis of morning circle at school showed an interestingly similar pattern to story reading in the home environment. In both activities, the adult, in this case the teacher, imposed a high degree of structure that was quite fixed and directed the interaction. The introduction of an SGD could therefore result in only minor interactional changes, which again was reflected in the topic analysis, where topic length actually decreased (table 2). Apart from this, many positive changes were seen during the intervention; most importantly, the pictures and the messages on the SGD increased James's engagement (table 1). The amount of irrelevant communication decreased when the SGD was used, as seen in the topic analysis, where almost all topic segments during SGD use concerned the ongoing activity (table 2). Regarding 'role in turn-taking', a marked increase in responses was noted (table 1). James was very good at using the SGD to answer his teacher's questions in the same way as the other students did. This was reflected in the increase in 'answering questions' and 'naming' (table 1). After the first intervention session, his teacher began to ask James to answer her questions orally as well. This explains the somewhat surprising pattern of 'effectiveness' where 'effective' contributions decreased and the category of 'not clearly effective' increased; in other words, James answered using the SGD, but instead of accepting that answer, the teacher asked him

resembled the clinical intervention. Both story reading and morning circle were controlled by the adult in the role of teacher and a high degree of structure was imposed. This meant that the impact of the SGD was limited to the predetermined activity pattern. Our team was not aware of this when the intervention and vocabulary were designed. As researchers, we found the degree of communicative control that was exercised by the parents and teacher during the activities to be surprisingly high. Self-awareness, with a focus on interaction and communication, therefore seems to be of the utmost importance. Instructions were given as part of the intervention, but they did not cover the basic aspects of communication. To become aware of and change behaviours, there is probably also a need for video observations.

Another important factor that became evident during the mealtime activity was the importance of identifying the communication needs during the activity. In this study, James was not interested in communicating during mealtime, but before lunch, while he was waiting, there were lots of good opportunities for communication, where topics other than food would probably have been more useful and motivating.

Taken together, these two findings indicate that the activity analysis, preferably based on a video observation, should have been done before the intervention; later, it should have been followed by another video-observation session when the SGD was introduced. This might have increased awareness of the activities, the existing interaction and communication patterns and potentially realistic goals.

Conclusions and clinical implications

The communication of a child with autism and mental retardation was studied when he was supplied with an SGD at home and at school. Many positive effects were seen. The boy was able to use his SGD to communicate more effectively with his parents; he was more engaged in the morning circle activity at school and consequently decreased his use of irrelevant speech. He was also able to construct sentences through

Endnotes

1 ChatBox is a dedicated speech-generating device manufactured by Saltillo Corporation. For further information contact Saltillo Corporation, 2143 TR112 Millersburg, OH 44654, USA, Telephone: 330.674.6722 Fax: 330.674.6726, www.saltillo.com

2 The Clicker software is a PC-based dynamic screen communication program. It allows the user to build personal applications, screens, learning activities and computer interfaces. It is manufactured by Crick Software Ltd, Crick House, Boarden Close, Moulton Park, Northampton NN3 6LF, UK, Telephone: +44 (0)1604-671691 Fax: +44 (0)1604-671692, www.cricksoft.com

3 Winmax is a small portable PC-based computer with a touch-screen. It is sold by Frölunda Data Försäljning AB, Långedragsvägen 48, 426 71 Västra Frölunda, Sweden. www.frolundadata.se.

4 Infovox is a diphone based text-to-speech software developed and sold in Sweden by BaBel Infovox AB, Englundavägen 7, P.O. Box 1328, 171 26 Solna, Sweden, Telephone: +46 (0)8 799 86 00, Fax: +46 (0)8 799 86 01, www.infovox.se

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Appendix 1

Communication Coding Scheme and definitions

The coding scheme and definitions applied in this study is an adaptation of the Communication Coding Scheme (CCS) developed by Romski and Sevcik (1996). The CCS in its original format was first tried out on some of the material in this study in a pilot study. Although the intervention used in Romski and Sevcik's research has served as one of the models for the intervention in this study, there also were differences in purposes and target group, which had to be accounted for. The above-mentioned pilot study also revealed that some of the definitions needed to be refined and changed based on this material. Some categories and traits were also added in order to control for factors of interest to this study.

The fundamental unit of coding in the modified CCS scheme is labelled a communicative event. A communicative event is best described as a contribution that can be transferred through different modes, for example, pointing and eye contact. The communicative event may in reality also have different communicative functions. Since most contributions fill many different functions at the same time, some of which cannot even be observed externally, the coding in this scheme refers to the function judged to be the main one. The choices can therefore be seen as categories, not traits. Without this categorization, both coding and interpretation of results would most probably be too complex and unreliable.

	subgroup of gesture and coded with a P in the scheme. A sign is defined as a conventionalized gesture (as it seems to be perceived by the partner and/or the coder), most often being used as an AAC method to support speech. Sign is also considered as a subgroup of gesture and marked with an S in the scheme.
Graphic representation	pointing, holding up, staring at or handing over a graphic representation, not combined with SGD activation. A graphic representation could be a photo, picture, symbol or written word.
SGD + graphic	activation of a Speech-Generating Device (SGD). Sometimes function buttons on the children's SGDs use speech output. In some cases, these buttons also convey a choice, for example of activity, and can therefore be seen as communicative at the same time. These speech output contributions are consequently coded in the scheme.
Vocalization	a sound or sequence of sounds that is not intelligible to the coder as a spoken word.
Speech	a sound sequence that is understood by the coder to be a word or phrase.
Communicative Function how the participant used the mode pragmatically. The choices should, as mentioned above, be seen as categories, not traits. The chosen category thus refers to the deemed main function.	
Answering question	responding to a question or a comment from a partner.
Affirming statement or comment	agreeing with a contribution or confirming a contribution or behaviour by the partner.
Negating statement or comment	objecting to the behaviour or verbalization/vocalization of a partner; for example, declining an object, action or event; or denying the existence of something.
Attention directing	engaging the attention of a partner toward oneself or another person, object or event.
Commenting previous contribution	communicating about what a partner has said, other than affirming or negating.

Appendix 2

Communication coding form

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SUM
Date																					
Activity																					
Degree of engagement																					
Time																					
Broad transcription																					
Role in turntakning																					
Response																					
Initiation																					
Mode																					
Phys Man																					
Eye contact																					
Gesture																					
Graphic																					
VOCA+graphic																					
Vocalization																					
Speech																					
Function																					
Answering question																					
Affirming statem/com																					
Negating statem/com																					
Attention Directing																					
Commenting prev contr																					
Commenting other																					
Requesting																					
Asking question																					
Greeting																					
Imitating																					
Naming																					
Naming action																					
Effectiveness																					
Effective																					
Not clearly effective																					
Unsuccessful																					