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McCann, Joanne, Peppé, Susan, Gibbon, Fiona E., O'Hare, Anne and Rutherford, Marion (2006) Receptive and expressive prosodic ability in children with high-functioning autism. QMU Speech Science Research Centre Working Papers, WP-6

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Speech Science Research Centre

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Working Paper WP-6

May 2006



Queen Margaret University College

EDINBURGH



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2002

Update and Sourcing Information May 2006

This paper is available online in pdf format

- 2006 onwards at <http://www.qmuc.ac.uk/ssrc>

Author Contact details:

- 2006 onwards at jmccann@qmuc.ac.uk

Subsequent publication & presentation details:

- Submitted for publication in Gomez, J., McGregor, E., Nunez, M. and Williams, K. (Eds.). *Autism: An Integrated View*. Oxford: Blackwell Publishing, due for publication 2007.

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The Prosody-Language Relationship in Children with High-Functioning Autism

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Abstract

In Kanner's original description of autism he noted disordered prosody as a common feature. Despite this, the area has received very little attention in the literature and those studies that have addressed prosody in autism have not addressed its relationship to other aspects of communication. This chapter will give an overview of research in this area to date and summarise the findings of a study designed to investigate the prosody and language skills of 31 children with high functioning autism. Two case studies of children with autism will be used to illustrate the relationship between language and prosody and to emphasise the prosodic impairment present in many children with autism.

1. Introduction

Unusual prosody was identified in people with autism was part of the original description by Kanner in 1943. A simple definition of prosody is that it refers to the manner in which things are said, not the content of what is said. The manner is conveyed by a number of different factors: variations in the relative pitch and duration of syllables, loudness of voice, pauses, intonation, speech-rate, stress and speech-rhythm. Disordered expressive prosody is widely reported to occur in the speech of people with autism (for example, Baltaxe, 1884; Fine, Bartolucci, Ginsberg and Szatmari, 1991 and Shriberg, Paul, McSweeny, Klin, Cohen and Volkmar, 2001) but very little research has been conducted on this aspect of autism: a recent review (McCann & Peppé, 2003) found only 16 studies between 1980 and 2002 on the topic. Of these, only two considered receptive prosodic disorder, which may not only account, at least in part, for expressive disorder, but also be related to the language disorders so frequently seen in autism. Our study therefore set out to assess the prosodic skills (expressive and receptive) and the language skills of children with autism, to find out how they are related. The following article describes the study, which is illustrated by two case-studies.

2. Background

Language in Autism

Impairment in language skills is one of the diagnostic features of the condition of autism (ICD-10, World Health Organisation, 1993; DSM-IV, American Psychiatric Association, 2000), but there is a considerable range of impairment. In low-functioning autism there can be a complete absence, at least of expressive language; in high-functioning autism, there can be intact phonological, grammatical and semantic systems, frequently with fluent speech and large vocabularies.

Kjelgaard and Tager-Flusberg (2001) investigated the communication ability of school-aged children with autism using standardised language measures similar to those used in the study described below, and concluded that the language impairment in children with autism is very variable (but that articulation skills are spared). They draw various parallels with the speech and language profiles of children with specific language impairment (SLI) suggesting genetic links between the two conditions. An earlier study by Tager-Flusberg (1981) suggested that children with autism had more severe comprehension and pragmatic deficits than children with developmental language disorders, and in particular that semantics was more impaired than grammar in the children with autism.

In broad agreement with Kjelgaard and Tager-Flusberg (2001), Rapin and Dunn (2003) note that children with autism have types of language disorder similar to those seen in children with SLI: the most frequently occurring profile of language impairment in both groups of children was a mixed receptive/expressive disorder with impairments in both syntax and phonology. In their cohort of pre-school children with autism, however, comprehension appeared to be universally impaired, whereas in

many of the children with language disorders there were expressive language impairments but intact comprehension.

Prosody in Autism

Research in this area has been sparse, as noted above, and somewhat conflicting (see McCann and Peppé, 2003). Like Kanner (1943), other authors have noted that expressive prosody can be atypical in autism, but the terms used are vague and unquantifiable e.g. “dull”, “wooden”, “singsong”, “robotic”, “stilted”, “over precise” and “bizarre” (Baltaxe & Simmons, 1985; Fay & Schuler, 1980). The terms can also be contradictory, e.g. “monotonous” as well as “exaggerated”, (Baron-Cohen & Staunton 1991), suggesting a wide variability in the kinds of atypical expressive prosody found in autism. More concretely, some early studies found that prosodic stress was often wrongly placed (Baltaxe 1984; Baltaxe & Simmons, 1985; Fine, Bartolucci, Ginsberg, & Szatmari, 1991), with a tendency to occur early in utterances (Baltaxe & Guthrie, 1987). In recent years there have been more studies involving greater numbers of participants and a more comprehensive approach to prosody, e.g. by Shriberg, Paul, McSweeney, Klin, Cohen, & Volkmar (2001), who found inappropriate or dysfluent phrasing as well as disordered placement of stress; and by Paul, Augustyn, Klin & Volkmar (2005), who examined receptive skills as well as expressive skills in several aspects of prosody but did not find significant differences between the performance of people with autism and that of unimpaired controls. Both these recent studies included people with Asperger's syndrome (AS) as well as those with high-functioning autism (HFA), and it is possible that the broad diagnosis may account for the lack of findings in Paul et al's study.

Prosody and Language

For some time now, receptive prosody has been thought to have primary importance in language acquisition. In a theory known as the ‘prosodic bootstrapping hypothesis’ (Morgan and Demuth, 1996) it is thought that infants need to be sensitive to prosodic differences to be able to segment the continuous speech-stream that is their first experience of language. Various studies (e.g. Jusczyk, Hirsh-Pasek, Kelmer Nelson, Kennedy, Woodward & Piwoz, 1992, Jusczyk, Cutler & Redanz, 1993) have demonstrated an association between prosody preferences in infants and developmental language disorders. Chiat (2001) argues convincingly for the importance of the mapping process for phonological processing and consequent lexical and syntactic development. As there has been no means of assessing receptive prosody skills in children who have acquired verbal skills, however, it is not known whether this relationship persists or what its nature is in later development.

3. A Study of Prosody and Language in Children with Autism

In order to address some of the problems of previous studies of prosodic skills in autism we will summarise a large study of prosody and language skills in children with HFA and further illustrate the relationship between prosody and language using two case studies. This large study aimed to determine the nature and relationship of McCann et al.

expressive and receptive language in school-aged children with HFA and determine how prosody relates to these abilities.

Participants

Thirty-one children with HFA were included in this study. The children were aged 6-13 years (mean age 9;9), and included 25 boys and 6 girls. All of the children had undergone multi-disciplinary assessment of their communication disorder and a consultant paediatrician had diagnosed the children during their pre-school years as having autism, with normal cognitive ability and early delay in speech/language development. Criteria included those described by Gillberg and Coleman (2000), ICD-10 (World Health Organisation, 1993), and a range of other autism assessment tools: the Childhood Autism Rating Scale (DiLalla & Rogers, 1994), Gilliam Autism Rating Scale (Gilliam, 1995), and Autism Diagnostic Observation Schedule (Lord, Risi, Lambrecht, Cook, Leventhal, & DiLavore, 2000).

The prosody assessment (PEPS-C) used in the study is not standardised and so a control group of 72 typically developing children matched for verbal mental age (using age equivalent scores from the BPVS-II, Dunn, Dunn, Whetton & Burley, 1997), sex and socio-economic status were recruited. These children were aged 4-11 years (mean age 6;9 years) with verbal mental ages between 4-12 years (mean 7;6 years). This group comprised 54 boys and 18 girls.

Children were excluded from both groups if any of the following 5 criteria applied: (1) English was not the child's first language and the main language of the home; (2) there was evidence of current hearing loss; (3) receptive language skills were <4 years; (4) there was a major physical disability or structural abnormality of the vocal tract; or (5) the family had lived in Scotland for <3 years (to minimise the effect of lack of familiarity with the Scottish accent on understanding of prosody). Children were excluded from the control group if they had any history of cognitive, speech or language impairment. Four children were excluded from the control group on the grounds that they had standard scores on the BPVS-II <85 and age-equivalent scores <4;0 years.

Language, Speech and Non-Verbal Assessments

The children with autism completed a battery of standardised speech, language and non-verbal assessments, a subset of which are reported here. Receptive language was measured using the British Picture Vocabulary Scales-II (BPVS-II, Dunn et al., 1997) and the Test for Reception of Grammar (TROG, Bishop, 1989). Expressive language was measured using the three expressive subtests of the Clinical Evaluation of Language Fundamentals-3UK (CELF-3UK, Semel, Wiig & Secord, 2000). To confirm the children's normal non-verbal ability the Raven's Progressive Matrices were used (RM, Raven, Court & Raven, 1986).

Prosody Assessment

Previously there has been no easy way to assess prosody. Profiling Elements of Prosodic Systems in Children (PEPS-C, Peppé & McCann, 2003) is a measure of both receptive and expressive prosody. The test consists of twelve subtests plus a vocabulary check test and follows a psycholinguistic framework; incorporating receptive and expressive tasks which are further divided into form (bottom-up processing where no meaning is involved) and function (top-down processing involving meaning). The test assesses the ability to understand and express prosody as used in four communicative functions in which prosody has a crucial role (Roach, 2000): turn-end, affect, chunking and focus. ‘Turn-end’ denotes the way speakers end a conversational turn, indicating by their intonation what sort of response they expect. ‘Affect’ refers to the attitudinal or emotional inflections conveyed by non-linguistic aspects of speech. ‘Chunking’ is the oral equivalent of punctuation, indicating how speech is delimited into meaningful units. ‘Focus’ encompasses the notion of emphasis on important parts of utterances. The tasks are as follows:

Function Tasks

Turn-end Type Reception (TR): Understanding whether an utterance requires an answer or not. Items are single words with intonation suggesting either questions or statements. In this task the child hears the name of a food with either rising intonation suggesting a question (e.g. “carrots?”) or falling intonation suggesting a statement (“carrots.”); the child is then asked to select one of two pictures on a computer screen corresponding to either a question or statement.

Turn-end Type Expression (TE): Producing single words with either intonation suggesting questioning or stating. Items are the same as those in the TR task. The child sees one picture on the computer screen, depicting either questioning (a person offering food on a plate) or stating (a person reading, with a call-out showing the food) and is asked to “say the name of the food as if you are asking me (the researcher) if I want some” OR to “say the name of the food as if you are telling me what it is”. Children’s responses are judged online by the researcher as questioning, stating or ambiguous.

Affect Reception (AR): Comprehending liking or disliking expressed on single words. The child hears names of food with prosody suggesting the speaker either likes or dislikes them, and is asked to select either a happy or sad face on the computer screen.

Affect Expression (AE): Producing affective intonation to suggest either liking or disliking on single words. The child sees a picture of a food on the computer screen and is asked to “say the name of the food so that I (the researcher) can tell if you like it or not”. Responses are judged by the researcher as likes, dislikes or ambiguous. Happy and sad faces then appear on the screen: children click on the one that demonstrates their actual preferences, for comparison with their verbal responses.

Chunking Reception (CR): Comprehending prosodic phrase boundaries. The child sees two sets of pictures on the computer screen, one depicting a compound noun plus a simple noun, the other depicting three simple nouns; for example, “chocolate-biscuits and jam” versus “chocolate, biscuits and jam”. The child hears an utterance with prosody suggesting one of these utterances and selects the appropriate picture on the screen.

Chunking Expression (CE): Producing prosodic phrase boundaries in phrases similar to those above. The child sees one set of pictures and is encouraged to say the

words with the appropriate phrase boundaries. The researcher judges the prosody as suggesting three items, two items or ambiguous.

Focus Reception (FR): Understanding contrastive stress. The child hears phrases such as: “I wanted BLUE and black socks” where one word (a colour) is stressed, and is asked to select the colour on the computer screen.

Focus Expression (FE): Using contrastive stress: This task consists of a game of “animal football” with variously coloured sheep and cows. The child hears a football commentator say an utterance which is incorrect and is asked to correct him. For example, if the child sees a picture of a blue cow and hears: “Now the green cow has the ball”, the required response is “No, the BLUE cow has it”. The researcher rates the child’s response as having contrastive stress on the colour, on the animal or elsewhere/ambiguous.

Form Tasks: Auditory Discrimination: The child’s ability to discriminate prosody is assessed using two tasks. Short-item Discrimination (SD) stimuli consist of laryngograph recordings (which sound like a hum) of items from the Affect and Turn-end reception tasks (single words). Long-item Discrimination (LD) stimuli consist of laryngograph recordings of items from the chunking and focus tasks. In both tasks the child hears two sounds (or sets of sounds in the LD task), and is asked to decide if they are the same or different.

Form Tasks: Imitation: The child’s ability to produce prosody is assessed in two imitation tasks. Short-Item Imitation (SI) stimuli consist of items from the affect and turn-end reception tasks (single words). Long-Item Imitation (LI) stimuli consist of phrases from the chunking and focus tasks. In both tasks the child hears the word or phrase and is asked to “try and copy the word/phrase, saying it in exactly the same way as the computer”.

A new computerised version of PEPS-C was used here (Peppé and McCann, 2003): the computerised version of the test has the advantage of making the auditory stimuli easy to administer, and responses are recorded directly onto computer. Most children, with or without autism, are able to complete the PEPS-C assessment in 50 minutes and enjoy using the computer. The stimuli were recorded in a Scottish-English accent, likely to be familiar to all the children.

As all of the items in the reception tasks are binary choice, a pass criterion was set at 75%, below which the element of chance in the scores would be considerable. All expression tasks require the tester to rate responses as either right (1 point), wrong (zero) or ambiguous (zero). The pass criterion is again set at 75% correct because often a child will produce all test items with the same prosodic form resulting in 50% correct because each expressive function task has two prosodic function targets. For example, in the Turn-end expression task it was common for young children to produce all the items with prosody suggesting all the items were statements. As half the stimuli were statements and half were questions this resulted in a score of 50% correct, but clearly a child who performs in such a way has not yet acquired the prosodic skills required to complete this task.

4. Results: Language Profiles of Children with HFA

Although there was heterogeneity among the autism group, all of the children except one had a score outwith the normal range on one or more of the language measures (BPVS, TROG and CELF). Table 1 shows the group results for all

measures; numbers are standard scores unless otherwise stated. Not all the children were able to complete all the measures so the number of children is given in each instance. For each standardised measure we calculated the percentage of children performing within normal limits (standard score 85 or more), with mild impairment (scores between 70 and 84) and with more significant impairment (scores of 69 or less). Paired t-tests were used to determine which aspects of language were most impaired.

TABLE ONE HERE

Receptive Language

Almost half (48%) of the children with HFA scored within normal limits on the BPVS-II, with the remaining children divided equally between mild and more significant impairment (26% in each category). For the TROG, 39% of the children scored within normal limits, with 32% showing mild impairment and 29% more significant impairment. A paired t-test showed that the BPVS-II scores and TROG scores were not significantly different ($p=0.835$). This may seem surprising given that the TROG is a more complex task (comprehension of phrases/sentences rather than single words), and in fact TROG scores were generally lower than BPVS-II scores.

Expressive Language

A minority of the children with autism (10%) scored within normal limits on the CELF-3UK expressive subtests; 26% had a mild impairment; 58% had a more severe impairment and 6% could not complete the test at all. Paired t-tests confirmed that performance on the CELF-3UK was significantly lower than on both the BPVS-II and TROG ($p<0.001$ in both cases) suggesting that in general expressive language is more severely impaired than receptive language. For some children this was a dramatic discrepancy of two standard deviations, or in one case three standard deviations.

The results of the language assessments support Kjelgaard and Tager-Flusberg (2001) who suggest that the language impairment in autism is similar to that of SLI. However, the results here suggest that unlike Kjelgaard and Tager-Flusberg's participants, expressive language is a particular difficulty for children with HFA. However, their study included children with a wider diagnosis of autism and it may be that an expressive deficit is a particular characteristic of children with HFA. To expand on this, it is possible that the additional learning difficulties of children with low functioning autism may produce additional language comprehension difficulties that therefore result in similar expressive/receptive abilities. Indeed, Kjelgaard and Tager-Flusberg found a significant relationship between IQ and language ability suggesting that children with additional learning difficulties do indeed have additional language difficulties.

5. Results: Prosody

An independent samples t-test revealed that the performance of children with autism was significantly lower than that of language matched peers ($p<0.001$, for McCann et al.

mean overall PEPS-C raw score). At subtest level, Affect Reception, Affect Expression, Short-Item Discrimination, Focus Expression, Long-Item Discrimination and Long-Item Imitation scores were all significantly lower (see Table 2 for significance levels).

TABLE TWO HERE

As PEPS-C is not standardised, it is not possible to determine if there is a more significant deficit than in the standardised language assessments. However, because the HFA and TD groups were matched on BPVS and the HFA group scored lower than the TD group, prosodic ability appears to be more impaired than receptive vocabulary. This suggests that children with autism have a specific difficulty with prosody, which is more severe than their deficit in receptive vocabulary. The majority (74%) of the HFA group scored below the pass criterion of 75%, suggesting a significant difficulty with prosody. However, these results must be interpreted with caution as almost half the younger children in the TD group also scored below this level (of children aged <7 years, 47.7% scored below 75%). Most of the children in the HFA group showed a significant deficit in prosody and all of them had difficulty with at least one of the PEPS-C subtests. By comparing the children with autism to language matched controls we see that prosodic ability was poorer in the children with autism, as a group. Had the experimental groups been matched on chronological age (as is the case in any standardised assessment) the difficulty with prosody would have been much more pronounced.

Comparing Language and Prosody

Raw scores on language measures were used to calculate correlations with prosody (PEPS-C) scores. Correlations with composite scores on receptive, expressive, function, and form prosody tasks were calculated. Table 3 shows the correlation co-efficient and probability values for each language measure and PEPS-C measure where the result was significant at the $p < 0.05$ level.

TABLE THREE HERE

PEPS-C total scores correlated highly with BPVS, CELF and TROG but not with chronological age.

Prosody: Reception and Expression

PEPS-C reception scores correlated highly with BPVS, TROG and CELF. In addition, PEPS-C reception scores correlated with non-verbal ability (RM) and age. Regarding PEPS-C expression tasks, there was a significant correlation with TROG and CELF.

Prosody: Function and Form

The PEPS-C function tasks assess the ability to use prosody meaningfully whereas form tasks assess the ability to discriminate and produce prosody without

reference to meaning, and these correlated with BPVS, TROG and CELF, whereas the expressive form tasks (imitation) did not correlate with any of the measures or with chronological age. BPVS and chronological age did however correlate with receptive form tasks (short-item discrimination and long-item discrimination). These are same/different tasks and it may be that the correlation is due to increased attention and auditory memory in older children. However, the lack of correlation between expressive form tasks (short-item imitation and long-item imitation) and any of the other measures suggests that the ability to imitate prosodic forms is unrelated to language skills or chronological age.

Some general patterns emerged regarding which aspects of prosody correlate most strongly with language. The Receptive function tasks (Affect Reception, Chunking Reception, Turn-end Reception and Focus Reception) were all related to at least two of the three language measures, whereas the expressive tasks were more variable. It might have been predicted that expressive language would relate to expressive prosody and receptive language to receptive prosody, but because of the high correlations between the three language measures it was not possible to draw any such conclusions.

6. Prosodic Impairment with and without Language Impairment.

Since prosody correlates strongly with language it is tempting to conclude that prosodic impairment is simply a manifestation of the severe language impairment that many children with autism have. Why this may or may not be the case is explored with two case studies of children with high-functioning autism. Fiona has a language impairment, typical of children with autism, whereas Ian has age appropriate language skills. Both of the children took part in the project described above investigating prosody and language skills in children with HFA.

Fiona

Fiona was aged 10;7 when she took part in the project. She attends a language unit attached to a mainstream school for children with autism spectrum disorders. Fiona has normal non-verbal ability demonstrated by a standard score of 110 on the Raven's Progressive Matrices. Fiona's language is severely impaired: Table 4 shows the results of her language assessments where it can be seen that she scored more than two standard deviations below the mean for all the language measures.

[TABLE FOUR HERE](#)

Fiona presented with disordered prosody, in that her speech sounded unusual. Her scores in the PEPS-C subtests were all below the "pass-mark" of 75% (12 out of 16) suggesting that Fiona has not mastered any of the prosody functions or forms assessed in PEPS-C. By comparing Fiona's performance with a group of typically developing children with a similar verbal mental age we can see a probable association between language impairment and prosodic impairment. Fiona's score on the BPVS translates to an age equivalent was 5.83 years, so her performance on the PEPS-C was compared with a control group of 18 typically developing children with a

mean BPVS age equivalent of 5.89 years (SD= 0.84). Table 5 shows a comparison between Fiona's scores on the PEPS-C and the scores of the control group.

[TABLE FIVE HERE](#)

Standard deviations in bold show where Fiona's score differed by more than one standard deviation from the control group (either above or below, marked by positive or negative numbers). She scored more than one standard deviation below the typical children on three subtests and more than two standard deviations below the typical children on a further three subtests. This marks a very significant deficit in Fiona's prosodic ability which is not wholly accounted for by her language impairment (since she has a language level similar to that of the control group). In contrast, Fiona actually scored more than one standard deviation above the typical children in the Turn-end reception task, but both Fiona and the typically-developing children failed to meet competence (a score over 12 or 75%, see above) in this subtest, which appears to tap into a skill which develops relatively late in typically-developing children.

In all standardised tests children are compared with peers of the same chronological age; if Fiona's performance had been considered in this way then the deficit in her prosodic skills would be even more pronounced. However, it is clear that Fiona has the disadvantage of both a language and prosodic impairment and that impaired prosody may be associated with impaired language. If we look at the results of the group study above we can see that Fiona's results are quite typical of children with high-functioning autism.

Ian

Ian was aged 13;6 when he took part in the project. He attends a special school for children with autism spectrum disorders. Ian has normal non-verbal ability demonstrated by a standard score of 90 on the Raven's Progressive Matrices. Ian's language is within normal limits: Table 6 shows his results on the language assessments.

[TABLE SIX HERE](#)

It can be seen that he scored within the normal range for all the assessments with the exception of the BPVS, where he scored slightly above the normal range, suggesting a relative strength in receptive vocabulary. Since Ian has normal language ability, his prosodic performance was compared with that of children of a similar chronological age as would be the case in any standardised assessment. Table 7 shows a comparison of his scores on the PEPS-C and those of a group of nine children of a similar age.

[TABLE SEVEN HERE](#)

Standard deviations in bold show where Ian's score differed by more than one standard deviation from that of the control group. Ian did not present with perceptually disordered expressive prosody; in other words, he sounded much like his peers; but he
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scored more than one standard deviation below them on three subtests and more than two standard deviations below them on a further four subtests. This marks a very significant deficit in his prosodic ability which is not in line with his language ability. He also scored below the “pass-mark” of 75% (12 out of 16) in four of the PEPS-C subtests (all expressive ones), while the control group achieved the pass criterion in all of the PEPS-C subtests, suggesting that prosody is usually well developed by age 13. Ian achieved scores at or near ceiling in some of the prosody tasks, however, suggesting an uneven profile of prosodic development.

The cases where Ian performed differently in parallel expressive and receptive tasks are perhaps particularly interesting: for example, he scored 14/16 (an adult-like score) on understanding of affect, but had great difficulty expressing affect. This suggests that although Ian can reliably understand the way other people use prosody to express emotions he can not reliably do so himself. A similar dissociation occurs on the Focus tasks: Ian outperformed his peers in perceiving contrastive stress (a skill that appears to be acquired late in typically-developing children), but his score was relatively low (although above the competence level) on the parallel expressive task, which requires no metaprosodic skill and is one where typically-developing children aged five frequently score at ceiling.

Although these two children demonstrate the wide variability in the HFA group, and Ian’s profile is very different from Fiona’s, it is interesting that they both show weaknesses in the areas where the majority of the HFA group had difficulty, i.e. in the expression of Affect and Focus and in imitation tasks.

Implications for Communication, Socialisation and Therapy: Fiona and Ian.

Disordered expressive prosody (unusual sounding speech) may make it difficult for speakers to integrate with their peers. In the case of Fiona this is indeed likely, compounding the problems of socialisation that are a defining feature of autism. On the other hand, Ian had perceptually normal prosody but a covert difficulty with tasks in which messages were differentiated by prosody alone, as required by an assessment such as PEPS-C. That is, although his prosody sounded normal in conversational speech he was not able to make use of prosody to express some of the functions when specifically asked to do so. This would make it difficult for Ian to use prosody for clarification in conversation. There is also the possibility that although he sounds as though his use of prosody will be normal, this may not be the case in practice; this would be both misleading and disconcerting.

One of Fiona’s main areas of difficulty was using and understanding affective prosody. A score of more than two standard deviations below the typically developing mean in the affect reception test shows that Fiona is unlikely to be able to judge another person’s feelings from intonation alone. This has implications for understanding emotions, beliefs and intentions generally, perhaps suggesting that this PEPS-C subtest involves aspects of theory of mind (ToM), known to be disordered in people with autism.

The clinical management implications of prosodic deficits in children with autism have not been well explored. Clinicians (speech and language therapists), have felt under equipped to assess and treat prosody. The prosody assessment described above is one way that clinicians can assess a child’s prosody to determine if children like Ian have covert prosodic difficulties, or if, as in Fiona’s case, unusual expressive

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prosody extends to receptive prosodic problems. However, there exist few therapy approaches for treating prosodic disorders in autism. One approach that is described by Golan and Baron-Cohen in chapter 13 successfully treats receptive affective prosody and it is possible that this could be extended to other types or prosody.

Although prosodic therapy approaches are scarce, clinicians can provide carers with advice to ensure that a child with autism is not disadvantaged by a receptive prosodic impairment by advising that speakers do not rely on prosody to get their message across. Similarly, if a child has difficulty using prosody functionally then listeners should take care not to rely on the child's prosody skills: for example, if a child has difficulty using affective prosody, then the listener cannot rely on prosody to interpret a child's attitude but must ask explicitly what or how the child is feeling.

7. Understanding the Prosody-Language-ToM Relationship in the Context of Autism Research.

Work by Rutherford, Baron-Cohen and Wheelwright (2002) suggests that the understanding of at least one aspect of prosody can be considered to be an advanced test of ToM. They investigated the ability of 19 adults with HFA or Asperger's syndrome (AS) to judge the affective meaning of forty phrases. Results showed that the HFA and AS group was impaired on this task compared with the performance of a large number of typical adults, and that the impairment did not correlate with verbal or performance IQs, and the authors concluded that affective prosody can be viewed as a ToM skill. Although language correlated closely with prosody in the large study of prosodic skills in children with autism described above, Ian's performance is a good illustration of how children with normal language skills can still have covert prosodic difficulties, suggesting the possibility of dissociation between prosody and language in at least some children with autism. The relationship between language impairment and ToM is, however, unclear: it is generally accepted that ToM correlates highly with language skills (Astington and Jenkins, 1999), but Leslie and Frith (1988) demonstrated that deficits in ToM are associated with factors other than language impairments: in matching children with autism to children with SLI, they found that school-aged children with autism had severe difficulty with ToM tasks whereas the children with SLI performed at ceiling.

It is notable that in this volume there are few papers that deal with impaired language skills in autism, although these constitute one of the three main diagnostic features of autism (Wing and Gould, 1979). It is also true that the study of prosody and language in autism has not been well explored in the context of cognitive theories, with most investigations of prosody in autism focusing on the behavioural aspects only. Integrative links with the findings of other autism studies are therefore scarce, although further research may establish an association between the types of auditory/neural processing and the deficits in language skills found in autism.

The findings in our study for imitation skills are, however, of interest in view of the research on mirror neurons described in Chapter 2. The author(s) propose that typical imitative development is marked by a shift from visuo-motor to social understanding and emotional connectivity, and that this shift is delayed in people with autism, such that they retain the ability to mimic (as a reflexive impulse) but do not develop the capacity to imitate for social or interactional purposes. It has been noted that children with autism mimic both the words and the prosody of speakers in

television shows and videos, apparently with no effort or awareness of doing so; yet they perform poorly on imitation tasks, and in this respect our study produces no surprises. Imitation tasks, including those in our study, do not, however, call for action understanding or intentional attribution, and therefore might be thought to require mimicry skills only.

The understanding and use of emotion is well described in autism, yet research which integrates neurocognitive, clinical and educational perspectives is lacking in the literature. Chapter 4 by Judith Piggot explored emotion attribution in autism with evidence from fMRI studies. This demonstrates, along with Chapter 13 by Golan and Baron-Cohen, that affect can be understood within domains other than prosody; for example, in facial expression, gesture, voice and face recognition (Hobson, 1986a; Hobson, 1986b; and Boucher, Lewis & Collis, 1998). Often these studies are conducted from a psychological rather than linguistic point of view: they therefore give interesting results about the use of prosody pragmatically but often do not explore prosody as an aspect of language or do not control stimuli linguistically. The Affect receptive task in the above study involves two skills: realising that other people's feelings may differ from one's own (a Theory of Mind skill), and inferring information on this point from minimal vocal and linguistic information; significant differences between experimental groups were seen. Our results and case studies therefore suggest that it is important for language to be considered when investigating affective and other types of prosody. Moreover, it is important that researchers appreciate that affect is expressed in several modalities. Indeed, the emotion-training software described by Golan and Baron-Cohen in Chapter 13 makes it explicit that affect is mediated via faces and voices (as well as language and gesture which are not covered in the software).

8. Conclusions

The widely reported unusual expressive prosody in people with autism spectrum disorders has been quantified by the findings of the above study and extended to show that children with autism also have difficulty understanding prosody. Furthermore, the results of the group study show that prosody relates closely to language skills, with reception skills appearing to have the greatest relationship. The case studies illustrate that the relationship is not straightforward, with covert prosodic deficits still observable in children without language impairments. More research is therefore needed to clarify whether the prosodic impairments shown by the children in the HFA group are directly associated with language impairments or an autism-specific difficulty. Clearly research has begun on understanding affective prosody in autism, with some work cutting across disciplines and approaches. However, other aspects of prosody such as pragmatic and linguistic prosody (for example that used in the Turn-end task above) have not yet been well explored across domains.

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Table 1: Results for Groups

	Children with Autism					TD Children	
Measure	BPVS-II	TROG	CELF	RM	PEPS-C %	BPVS-II	PEPS-C %
No. Complete	31	31	29	30	31	72	72
Mean	81.4	79.6	69.8	96.4	64.6	107.5	75.0
SD	16.2	17.9	8.5	15.9	11.0	9.3	9.5

Table2: Prosody Results for Groups.

Subtest	TR		TE		AR		AE		SD		SI		CR		CE		FR		FE		LD		LI		Total	
	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD	HFA	TD
Mean	65.9	64.8	68.1	74.2	71.2	84.5	63.3	79.4	68.8	80.1	64.7	79.9	67.5	69.0	66.5	71.2	59.6	65.9	61.6	84.0	63.5	79.0	65.7	85.4	64.6	76.3
STDEV	21.4	18.1	21.8	18.3	21.6	11.4	26.3	19.2	22.0	17.4	26.4	18.0	15.7	15.6	20.6	11.8	19.0	19.1	26.4	15.0	23.1	13.3	22.0	11.4	11.0	9.5
Sig level	ns		ns		p=0.003		p=0.001		ns		p=0.003		ns		ns		ns		p<0.0001		p=0.001		p=0.000		p<0.0001	

TR= Turn-end Reception, TE= Turn-end Expression, AR= Affect Reception, AE=Affect Expression, SD= Short-item Discrimination, SI=Short-item Imitation, CR= Chunking Reception, CE=Chunking Expression, FR=Focus Reception, FE=Focus Expression, LD=Long-item Discrimination, LI= Long-Item Imitation.

Significance level is set at p<0.0038 to take account of Bonferroni adjustment.

Table 3. PEPS-C, language, non-verbal and age correlations for HFA group.

PEPS-C Task	BPVS	TROG	CELF	RM	Age
Total	r=0.559;p=0.001	r=0.604;p<0.0001	r=0.680;p<0.0001		
Reception Total	r=0.779;p<0.0001	r=0.585;p=0.001	r=0.717;p<0.0001	r=0.502;p=0.005	r=0.598;p<0.0001
Expression Total		r=0.507;p=0.004	r=0.498;p=0.006		
Function Total	r=0.501;p=0.004	r=0.614;p<0.0001	r=0.718;p<0.0001		
Form Total					
Turn-end Reception	r=0.630;p<0.0001		r=0.502;p=0.006	r=0.488;p=0.007	r=0.459;p=0.009
Turn-end Expression	r=0.568;p=0.001	r=0.480;p=0.007	r=0.678;p<0.0001	r=0.517;p=0.005	
Affect Reception	r=0.597;p<0.0001	r=0.522;p=0.003	r=0.684;p<0.0001		
Affect Expression					
Chunking Reception	r=0.546;p=0.001	r=0.630;p<0.0001			
Chunking Expression					
Focus Reception	r=0.579;p=0.001		r=0.555;p=0.002		r=0.475;p=0.008
Focus Expression		r=0.718;p<0.0001	r=0.540;p=0.003		
Intonation Reception	r=0.579;p=0.001		r=0.542;p=0.002		r=0.514;p=0.003
Intonation Expression					
Prosody Reception	r=0.460;p=0.009			r=0.508;p=0.005	r=0.584;p=0.001
Prosody Expression					

Note: Only correlations significant at the $p < 0.05$ level are reported. Blank cells are not significant

Table 4: Standardised assessment results for Fiona

Fiona	Standard Score	SD	Age Equivalent
BPVS	65	>2	5;10
TROG	63	>2	5;0
CELF	64	>2	4;5
RM	110	0	

Table 5: Prosody Results for Fiona and TD controls.

	PEPS-C Subtest													
	AGE	BPV												
	S AE		TR	TE	AR	AE	SD	SI	CR	CE	FR	FE	LD	LI
TD Mean	5.53	5.89	7.89	10.11	12.33	11.22	10.94	10.67	9.50	11.06	9.22	13.17	10.78	12.22
TD SD	0.17	0.84	1.71	2.54	1.91	3.95	3.39	3.08	2.53	1.86	2.58	1.58	2.16	2.46
Fiona	10.58	5.83	10	8	8	11	6	7	7	7	8	9	10	9
SD from TD Mean			+1.23	-0.83	-2.27	-0.06	-1.46	-1.19	-0.99	-2.18	-0.47	-2.64	-0.36	-1.31

TR= Turn-end Reception, TE= Turn-end Expression, AR= Affect Reception, AE=Affect Expression, SD= Short-item Discrimination, SI=Short-item Imitation, CR= Chunking Reception, CE=Chunking Expression, FR=Focus Reception, FE=Focus Expression, LD=Long-item Discrimination, LI= Long-Item Imitation.

Table 6: Standardised assessment results for Ian.

Ian	Standard Score	SD	Age Equivalent
BPVS	117	+1	16
TROG	89	0	10
CELF	95	0	11
RM	90	0	

Table 7: Prosody Results for Ian and TD controls.

			PEPS-C Subtest												
	AGE	BPV	TR	TE	AR	AE	SD	SI	CR	CE	FR	FE	LD	LI	Total
TD Mean	13.37	13.45	14.56	15.00	14.89	15.11	15.67	13.78	14.78	13.33	13.78	14.44	15.44	15.56	176.33
TD SD	1.07	1.39	1.67	1.73	1.62	1.36	0.50	2.31	1.48	1.41	1.86	1.33	0.73	0.77	8.20
Ian	13.5	16	16	15	14	7	16	4	12	9	16	13	15	6.5	143.5
SD from TD Mean			0.87	0.00	-0.55	-5.95	0.67	-4.24	-1.88	-3.06	+1.20	-1.08	-0.61	-11.79	-4.00

TI= Turn-end Reception, TO= Turn-end Expression, AI= Affect Reception, AO=Affect Expression, SD= Short-item Discrimination, SI= Short-item Imitation, CI= Chunking Reception, CO=Chunking Expression, FI=Focus Reception, FO=Focus Expression, LD=Long-item Discrimination, LI= Long-Item Imitation.