INT J LANG COMMUN DISORD, NOVEMBER–DECEMBER 2010,
VOL. 45, NO. 6, 681–690

informa
healthcare

Research Report

Preschoolers with autism show greater impairment in receptive compared with expressive language abilities

Kristelle Hudry†, Kathy Leadbitter‡, Kathryn Temple§, Vicky Slonims¶, Helen McConachie§, Catherine Aldred‡,*, Patricia Howlin‖, Tony Charman† and the PACT Consortium

†Centre for Research in Autism and Education, Department of Psychology and Human Development, Institute of Education, London, UK
‡Psychiatry Research Group, University of Manchester, Manchester, UK
§Institute of Health and Society, Sir James Spence Institute, Royal Victoria Infirmary, Newcastle University, Newcastle Upon Tyne, UK
¶Guy's Hospital, Newcomen Centre, London, UK
*Stockport Primary Care Trust, Stockport, UK
‖Department of Psychology, Institute of Psychiatry, London, UK

(*Received April 2009; accepted November 2009*)

Abstract

Background: In early typical language development, children understand words before they are able to use them in speech. Children with autism spectrum disorders (ASD) generally show impairments in both the comprehension and the production of language. However, the *relative* degree of delay or impairment in each of these sub-domains may also be atypical and remains less well-understood.
Aims: Relative delay in receptive and expressive language skills was examined within a large sample of preschoolers with autism. Children's language abilities varied from pre-verbal to fluent speech.
Method & Procedures: Scores on one direct clinician assessment and two parent-report measures of language were obtained for 152 preschoolers with core autism.
Outcomes & Results: As expected, on average, the language ability of the children with autism was lower than typical age norms, albeit with substantial individual variability. On all three language measures, receptive ability was relatively more impaired than expressive ability. Higher non-verbal ability was associated with such an atypical language profile.
Conclusions & Implications: Recognition of the marked receptive language impairment relative to expressive language, found to affect at least one-third of preschoolers with autism in this sample, has important implications for interacting with these children and for informing appropriate targets in language and communication intervention.

Keywords: autism, children, preschool, receptive language, expressive language.

What this paper adds

Impairments in both language comprehension and production are well-established in children with ASDs. However, the relative degree of delay or impairment in each of these areas remains less well-understood, and early evidence suggests that comprehension may be relatively more impaired than production.

Receptive skills were found to be relatively more impaired than expressive skills in this large sample of preschoolers with core autism. This finding was even more pronounced than that reported for previous samples of children with broader ASDs, with around 30% of children here displaying a markedly atypical profile of raw expressive vocabulary approaching receptive vocabulary level (rather receptive vocabulary being well in advance, as is the case in typical language development).

Such an atypical language profile has implications for the way in which we interact with children with ASD and target language and communication intervention.

Address correspondence to: Kristelle Hudry, Centre for Research in Autism and Education, Department of Psychology and Human Development, Institute of Education, 25 Woburn Square, London WC1H 0AA, UK; e-mail: k.hudry@ioe.ac.uk

International Journal of Language & Communication Disorders
ISSN 1368-2822 print/ISSN 1460-6984 online © 2010 Royal College of Speech & Language Therapists
http://www.informahealthcare.com
DOI: 10.3109/13682820903461493

Introduction

First signs of word comprehension in typically developing infants emerge around 9 months of age with spontaneously spoken words following at around 12 months (Fenson *et al.* 1994). By this age, however, infants have developed understanding of many more words as well as of some short phrases (Tager-Flusberg and Caronna 2007), but will not be able to produce any phrases of their own until between 18 and 24 months of age (Fenson *et al.* 1994). While there is substantial individual variability around this trajectory, the development of language comprehension must always occur ahead of production, as children cannot functionally use words which they do not understand. Fenson *et al.* (1994) demonstrated the marked growth in comprehension over production skills in a normative study of infant language development, plotting parent-reported receptive and expressive vocabulary counts on the MacArthur–Bates Communication Development Inventory (MCDI; Fenson *et al.* 1992: 65).

Communication is one of three domains of core diagnostic impairment in the autism spectrum disorders (ASD; World Health Organisation (WHO) 1993). Language skills are usually also impaired and serve an important prognostic function. Children with autism and more advanced early vocabulary and language demonstrate better later language abilities (Venter *et al.* 1992, Szatmari *et al.* 2003, McDuffie *et al.* 2005) and the acquisition of speech by 5 years of age has been shown to be predictive of more positive long-term outcome (Rutter 1970, Venter *et al.* 1992). Language abilities vary widely in ASD (Kjelgaard and Tager-Flusberg 2001, Charman *et al.* 2003, Smith *et al.* 2007) and can be difficult to ascertain with confidence, both in structured assessments and in functional daily use (Tomasello and Mervis 1994, Koegel *et al.* 1997, Charman *et al.* 2003, Charman 2004). Specifically, the level of comprehension skill can be difficult to gauge as individuals with ASD may respond inconsistently during a specific assessment and other everyday situations, and with different conversational partners. Words may also be produced without meaning, as in echolalia.

Not only are language comprehension and production delayed in children with ASD (Charman *et al.* 2003, Charman 2004, Mitchell *et al.* 2006), but also the relationship between these two domains may be unusual in that comprehension lags behind expressive language development. Luyster *et al.* (2008) and Kjelgaard and Tager-Flusberg (2001) found relatively greater impairment in comprehension over production skills in toddlers and children with ASD. However, this atypical pattern was evident only when using certain measures of communication. While Luyster *et al.* (2008) found relatively greater impairment in comprehension over production using measures of early communication skills and parent-reported vocabulary (Mullen Scales of Early Learning; Mullen 1995; and MCDI; Fenson *et al.* 1992), they failed to find this pattern in using a parent-reported measure of functional communicative behaviours (Vineland Adaptive Behaviour Scales; Sparrow *et al.* 1984). Similarly, Kjelgaard and Tager-Flusberg (2001) reported greater impairment in higher-order receptive over expressive language skills (using subtests of the Clinical Evaluation of Language Functions — III; Semel *et al.* 1995), but found no such difference between receptive and expressive single-word vocabulary scores (comparing the Peabody Picture Vocabulary Test; Dunn and Dunn 1997; and the Expressive Vocabulary Test; Williams 1997).

Only one further study has addressed this issue in toddlers with ASD at the earliest stages of language development. Like Luyster *et al.* (2008), Charman *et al.* (2003) asked parents of a large group of toddlers and young children with broad-ranging ASD diagnoses to complete the MCDI Infant form (that is, Words and Gestures; Fenson *et al.* 1992), providing counts of receptive and expressive vocabulary. Comparison with the normative data of Fenson *et al.* (1994) indicated relatively greater impairment in receptive over expressive vocabulary for the children with ASD diagnoses. This discrepancy was even more marked than that reported by Luyster *et al.* (2008).[1] While the average toddler who understands more than 200 words typically produces only around 45 words (Fenson *et al.* 1994), children with ASD do not demonstrate this level of comprehension until they can produce an average of 57 (Luyster *et al.* 2008; 18–33 month olds) to 126 words (Charman *et al.* 2003; 18–88-month olds). Toddlers and young children with ASD therefore appear to understand proportionately fewer words than expected on the basis of their expressive vocabularies.

The aim of the current study was to further investigate the relative pattern of receptive and expressive language abilities, in a large sample of preschool children with diagnoses of 'core' childhood autism (WHO 1993). Multiple measures (direct assessment and parental report by questionnaire and interview) were used to evaluate this sample at the earliest stage of language development. Given their autism, the children were expected to underperform, on average, compared with age norms. They were also expected to show relatively greater impairment in receptive over expressive language. An exploration was also conducted on the impact of factors such as chronological age (CA), non-verbal ability, adaptive functioning, and autism symptom severity on relative profiles of receptive and expressive language ability.

Methods

Participants

This study was conducted using baseline assessment data collected as part of the Preschool Autism Communication Trial (PACT; http://www.medicine.manchester.ac.uk/pact/; ethical permission was granted by the Central Manchester Multicentre Research Ethics Committee, 05/Q1407/311). A group of 152 children (14 female) aged between 24 and 59 months (mean = 44.83, standard deviation (SD) = 7.98) was recruited to PACT via referral from local paediatric, mental health, and speech and language therapy services across three UK sites — South London, Greater Manchester, and the North-East of England. For trial entry, children were required:

- To have likely or confirmed diagnosis of autism by local service providers.
- To reach threshold on at least two of the three domains — reciprocal social interaction, communication, and restricted behaviours and repetitive interests — on the Autism Diagnostic Interview — Revised (ADI-R; Lord *et al.* 1994), as well as meeting the *onset* criterion.
- To meet criteria for 'autism' on the Autism Diagnostic Observation Schedule — Generic (ADOS-G; Lord *et al.* 2000); defined as reaching threshold for 'autism' on both the *social* and *communication* algorithm subscores as well as on the *total* algorithm score.
- To demonstrate non-verbal ability above 12 months age-equivalence (AE) on the Visual Reception and Fine Motor subscales of the Mullen Scales of Early Learning (MSEL; Mullen 1995).

Whilst many families spoke additional languages other than English, participation in the trial required parents to have good fluency with English and to use this language regularly in interaction with their child with autism. Descriptive characteristics for the sample are presented in table 1.

Children's families varied in terms of composition (22% single-parent and 78% dual-parent families). Socio-economic status was also varied (32% of families had annual household incomes below £20 000; 34% earned between £20 000 and £40 000; 25% earned between £40 000 and £60 000; and 9% of families had incomes greater than £60 000) as was child ethnicity (56% White, 28% Black, 5%, Middle-Eastern and Asian, and 11% mixed-race).

Procedure and measures

The data presented here were collected at baseline assessment in the trial, before randomization or delivery of any trial intervention. Assessments were conducted over two or three visits by one of three research teams based across the PACT recruitment sites. The ADI-R (Lord *et al.* 1994) and Vineland Adaptive Behaviour Scales — 2nd Edition, Survey Form (VABS; Sparrow *et al.* 2005) were completed at an initial home or clinic visit with parents. Subsequently, families attended the clinic for direct assessment of the child, including the ADOS-G (Lord *et al.* 2000; Modules 1 or 2), Preschool Language Scales — 3rd Edition, UK adaptation (PLS; Zimmerman *et al.* 1997), and the non-verbal subscales of the MSEL (Mullen 1995). Before or during this session, parents completed the MCDI (Infant form; Fenson *et al.* 1992). Assessment sessions were held 21.6 days apart on average (SD = 17.4 days, range = zero days to 3.5 months). The order of test administration was flexible within and across sessions, so as to cater for the needs of individual children and families, and additional sessions were scheduled to complete testing where necessary. This enabled multiple measures of language and communication to be obtained for each of the 152 child participants with only very minimal data loss (exact *N*s for each instrument are presented in table 2).

Table 1. Sample descriptive characteristics

	Mean	SD	Range
Chronological age (months)	44.8	8.0	24–59
MSEL[a] non-verbal ability, $n = 152$			
Age equivalence (months)	26.1	9.8	12–61
Developmental quotient	58.3	17.5	26–112
ADOS[b] total algorithm scores			
Module 1, $n = 117$	17.0	2.7	12–22
Module 2, $n = 35$	16.1	2.7	12–22
ADI-R[c] algorithm scores, $n = 152$			
Social interaction	19.4	4.3	8–30
Communication[d]	13.0	3.3	4–25
Restricted/repetitive	5.4	2.1	0–12
Onset	4.2	0.8	2–5

Notes: SD, standard deviation. [a] Mullen Scales of Early Learning (Mullen 1995). [b] Autism Diagnostic Observation Schedule (Lord *et al.* 2000). [c] Autism Diagnostic Interview — Revised (Lord *et al.* 1994). [d] Scores are algorithm totals of non-verbal items for those children with no speech, and totals of verbal and non-verbal items for those children with speech.

Table 2. Inter-correlation matrix between PLS and VABS receptive (rc) and expressive (ex) AE scores and MCDI raw rc and ex vocabulary counts

	PLS rc	PLS ex	VABS rc	VABS ex	MCDI rc	MCDI ex
PLS[a] rc		0.60	**0.42**	0.42	**0.43**	0.54
PLS ex	0.86		0.48	**0.58**	0.47	**0.63**
VABS[b] rc	**0.68**	0.70		0.67	**0.58**	0.57
VABS ex	0.81	**0.84**	0.79		0.72	**0.73**
MCDI[c] rc	**0.76**	0.76	**0.74**	0.87		0.76
MCDI ex	0.84	**0.85**	0.75	**0.89**	0.88	

Notes: Shaded cells present full correlations, whilst unshaded cells present partial correlations controlling for the effects of non-verbal age-equivalence (AE). Cells in bold font indicate correlations between similar sub-domains across the different measures. All associations (including those in normal font) are at $p < 0.001$. [a] Preschool Language Scales — III — UK Edition (Zimmerman *et al.* 1997). [b] Vineland Adaptive Behaviour Scales — II (Sparrow *et al.* 2005). [c] MacArthur–Bates Communication Development Inventory (Fenson *et al.* 1992).

Results

Many children achieved floor-level standardized scores on each of the receptive and expressive scales of the PLS (that is, a score of 50; $n = 65$ and 49, respectively), therefore analyses using this measure and the VABS were conducted with age-equivalent (AE) scores. On the MCDI, however, AE scores could be computed for only fewer than half of all children (for receptive $n = 65$ and expressive vocabulary counts $n = 45$), due to the narrow age range of the standardization sample (8–16 months). For this instrument, raw receptive and expressive vocabulary counts were therefore calculated (maximum possible = 396 words for each).

Receptive and expressive sub-domain scores were highly inter-correlated both within and across the three assessment measures used. Non-verbal ability was also very highly associated with receptive and expressive scores across the three measures (*r*s ranging from 0.59 to 0.87, all *p*s < 0.001). Zero-order and partial correlations (controlling for non-verbal age-equivalence (NVAE)) are presented in table 2. There was high-level agreement between direct assessment and parent report, with correlation coefficients generally higher amongst direct- and parent-reported expressive scores than amongst comparable pairs of receptive scores.

Table 3 presents children's mean receptive and expressive scores on each of the language measures, with standard deviations reflecting the large degree of individual variability present in each of these areas as measured by both the PLS and the VABS. Paired samples *t*-tests (table 4) confirmed that the children's mean receptive and expressive language scores fell well below both their mean CA and their mean NVAE scores. On both of these standardized assessment measures, children showed consistently greater impairment in receptive compared with expressive skills; PLS, $t(150) = -2.94$, $p = 0.004$; VABS, $t(151) = -6.12$, $p < 0.001$.

Table 3. Mean child performance on each language assessment measure

	n	Mean	SD	Range
PLS[a] *AE (months)*				
Receptive	151	17.8	12.7	3–59
Expressive	151	19.4	11.6	4–77
VABS[b] *AE (months)*				
Receptive	152	15.1	8.8	0–41
Expressive	152	18.2	10.2	1–43
MCDI[c] *raw vocabulary counts*				
Receptive	148	159.6[d]	120.1	0–392
Expressive	147	100.4[d]	121.2	0–391

Notes: SD, standard deviation. [a] Preschool Language Scales — III — UK Edition (Zimmerman *et al.*, 1997). [b] Vineland Adaptive Behaviour Scales — II (Sparrow *et al.*, 2005). [c] MacArthur–Bates Communication Development Inventory (Fenson *et al.* 1992). [d] Raw scores.

Table 4. Difference tests between group mean PLS and VABS receptive and expressive AE scores and group mean CA and NVAE

	Comparison with group CA[c]		Comparison with group NVAE[d]	
	t-test	*p*	*t*-test	*p*
PLS[a] *AE (months)*				
Receptive	$t(150) = 28.58$	< 0.001	$t(150) = 16.12$	< 0.001
Expressive	$t(150) = 27.87$	< 0.001	$t(150) = 11.26$	< 0.001
VABS[b] *AE (months)*				
Receptive	$t(151) = 37.20$	< 0.001	$t(151) = 16.13$	< 0.001
Expressive	$t(151) = 33.46$	< 0.001	$t(151) = 14.70$	< 0.001

Notes: [a] Preschool Language Scales — III — UK Edition (Zimmerman *et al.* 1997). [b] Vineland Adaptive Behaviour Scales — II (Sparrow *et al.* 2005). [c] Chronological age. [d] Non-verbal age equivalence as assessed by the visual-reception and fine-motor subscales of the Mullen Scales of Early Learning (Mullen 1995).

To permit comparison of the children's relative receptive and expressive abilities on the raw MCDI vocabulary counts, six subgroupings were created on the basis of receptive count (as per Fenson *et al.* 1994; representing counts of 0–20, 21–50, 51–100, 101–150, 151–200, and 201+ words understood). Expressive counts were plotted as a function of these receptive subgroupings. Figure 1 presents the mean of this relative receptive-expressive association for the current sample, along with the previously-published data for samples of children with broader ASD diagnoses (Charman *et al.* 2003, Luyster *et al.* 2008; data points reproduced with permission), and also the typical normative data of Fenson *et al.* (1994). Compared with both the normative profile and also

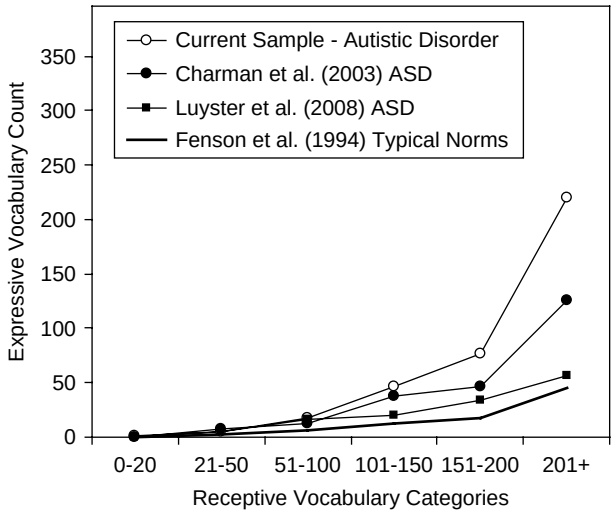

Figure 1. Profiles of mean expressive vocabulary count at different subgroupings of receptive vocabulary count, for the current sample of children with autism, previously reported data from samples of children with broader ASD diagnoses (Charman *et al.* 2003, Luyster *et al.* 2008), and norms for typically developing toddlers (Fenson *et al.* 1994).

to the profiles of children with broader ASD diagnoses, the current data show a steeper relative association of receptive and expressive vocabulary skills. Inspection of the data suggests that, excluding the lowest receptive ability groupings (that is, children understanding fewer than 100 words), parents report larger expressive vocabularies for their children with autism and ASD than for typically developing children. Furthermore, at the higher subgroupings of receptive ability level (that is, children understanding more than 100 words), parents of children with autism in the current sample report larger expressive vocabularies than do parents of children with broader ASDs (cf. Charman *et al.* 2003, and Luyster *et al.* 2008).

Figure 1 clearly demonstrates the relative expressive advantage over receptive skills in this sample. While the group mean receptive vocabulary count presented in table 3 clearly exceeds the group mean expressive count, indicating higher raw receptive compared with expressive ability, it is important to remember that this discrepancy, in typically developing children at the same level of receptive ability, would be far greater (for example, only around 20 words would likely be produced when comprehension was at the level of 160 words, Fenson *et al.* 1994: table 11, p. 66).

The range of raw vocabulary scores also presented in table 3 indicates the large degree of individual variability present in the children's receptive and expressive abilities. Of the 147 children with full data available on the MCDI, a number were at floor level (that is, with no receptive [$N = 3$] or expressive words [$N = 28$]). While a few children achieved very high scores (more than 390 receptive [$N = 3$] or expressive words [$N = 1$]), no child scored at ceiling (that is, 396 words). Inspection of the scatter of children's expressive and receptive vocabulary counts demonstrated substantial individual variation in relative ability between these language sub-domains. While some children with autism could clearly comprehend more words than they could say, many also displayed closely similar raw levels of vocabulary comprehension and production. Given the wide individual variation in relative receptive and expressive vocabulary counts in typical development, the current data were compared with those of the normative sample of Fenson *et al.* (1994). Across the various receptive subgroups, 61 children with autism (42%) had expressive vocabulary counts within the typical 75th percentile of ability. More conservatively, 103 children with autism (68%) had expressive vocabulary counts within the typical 95th percentile of ability. Therefore, around 30% of this sample of children with autism ($N = 44$) had unusually high expressive vocabulary counts, given their level of receptive ability (figure 2).[2]

Based on the conservative 95th percentile cut-off[3] for typical normative receptive-expressive vocabulary association, children in the current sample identified as 'typical' (that is, productive < receptive vocabulary)

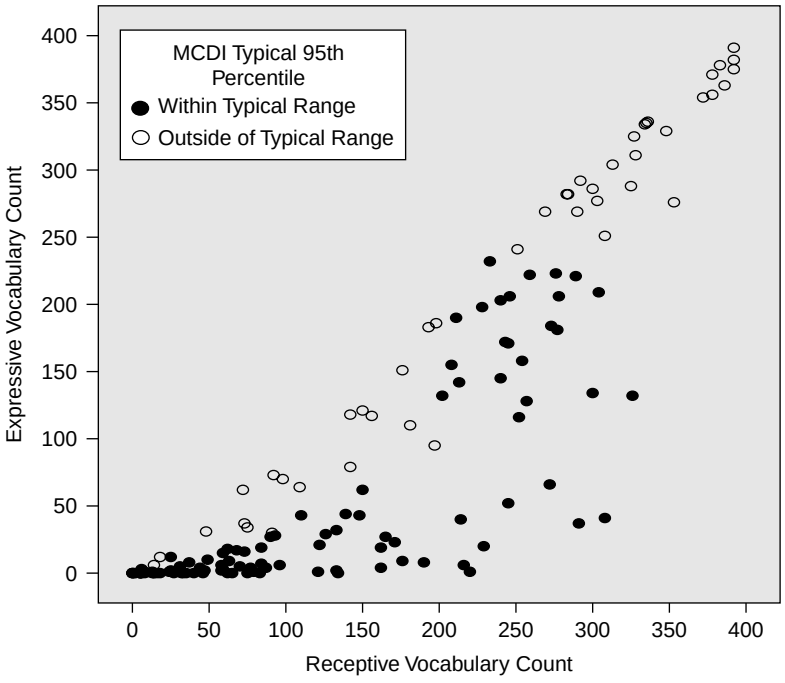

Figure 2. Scatter of individual children's receptive and expressive raw vocabulary counts, as reported by parents on the MCDI. Subgroups represent those children whose expressive scores fell within (dark points) and outside of (light points) the typical 95th percentile of ability, given their associated levels of receptive ability.

or 'atypical' (that is, productive > receptive vocabulary) were compared on a number of variables: CA, NVAE (measured by the MSEL), adaptive functioning (measured by the VABS Adaptive Behavior Composite score), and autism symptom severity levels (measured by the ADOS total algorithm score). Subgroup means on each of these measures, and significance-test results are presented in table 5. The 45 children with atypical relative receptive language impairments were older, more able in terms of NVAE and adaptive functioning, and received lower scores on the ADOS (albeit remaining within the autism cut-off). Entry of these four variables as predictors of relative language typicality/atypicality in a logistic regression revealed significant predictive value of the model, $\chi^2(4) = 48.30$, $p < 0.001$ (Cox & Snell $R^2 = 0.28$; Nagelkerke $R^2 = 0.40$) resulting in 78.2% correct classification. Of the four variables entered, however, only NVAE was found to be a significant univariate predictor, $\beta = 0.11$, $p = 0.001$, yielding 77.6% correct classification when entered alone.

Discussion

Language skills were assessed in a large sample of well-characterized preschoolers with core childhood autism, using multiple measures to evaluate the relative profile of early emerging comprehension and production abilities. Wide individual variation on the standardized measures was evident, with some children completely non-verbal and others performing at age-appropriate levels. However, as expected, the group as a whole showed clearly impaired comprehension and production of language, compared with both age-norms and the children's own non-verbal ability levels. Furthermore, on the two assessment measures for which norm-referenced (that is, AE) scores could be computed — the PLS and the VABS — greater impairment was seen in the children's receptive compared with their expressive skills.

Norm-referenced scores could not be readily computed on the third language measure — counts of receptive and expressive vocabulary in the MCDI. However, significant attainment delay here was also demonstrated in the presence of some floor effects in the data. Further, administration of the Infant form (normally only appropriate for infants up to 16 months of age) should have resulted in ceiling scores for this group of preschool-aged children (mean age = 44.8 months). However, no such effect was apparent. Evaluation of raw receptive and expressive vocabulary counts also presented a clear picture of relatively greater impairment in receptive over expressive skills in children with autism compared with the normative pattern. At least one-third of the current sample presented an atypical relative vocabulary profile (falling outside of the 95th percentile score of Fenson et al.'s 1994, normative sample), with receptive vocabulary counts significantly lower than expected on the basis of expressive counts. Such a finding of relatively greater receptive impairment agrees with, and is even more pronounced than, that previously reported for samples of children of comparable age but broader-ranging ASD diagnoses (Charman *et al.* 2003, Luyster *et al.* 2008).

In combination, these results present a convergent picture of relatively greater impairment in receptive compared with expressive language abilities in preschoolers with autism, as evidenced using measures which rely on different assessment techniques (that is, direct assessment and parent report) and which tap different types of language skill (including single-word vocabulary, semantic and syntactic aspects of language, and functional communication). Individuals' scores for both receptive and (particularly) expressive abilities were highly associated across the assessment tools, supporting the consistency of this finding across multiple measures. While expressive deficits are present and often clearly observable in childhood autism, for many the less easily ascertainable domain of language comprehension is affected to an even greater extent (for further discussion on this point, see Tager-Flusberg *et al.* 2005).

Mean scores for the PLS and VABS and comparison of relative MCDI plots with those from normative data evidence this relatively greater impairment in receptive over expressive abilities for children with autism, as a group. At the individual level, however, variation was

Table 5. Mean scores and significance-test results between subgroups of children with typical/atypical association between receptive and expressive vocabulary counts on the MCDI, on potential predictor variables

	Subgroup mean scores (SD)		
	Within 95th percentile ($n = 102$)	Outside of 95th percentile ($n = 45$)	t (d.f.)
Chronological age	43.0 (7.9)	48.5 (6.7)	−4.0 (145), $p < .001$
MSEL[a] AE	22.6 (7.3)	34.4 (10.1)	−7.0 (63.1), $p < .001$
ADOS[b] total	17.2 (2.6)	15.6 (2.6)	3.4 (145), $p < .001$
VABS[c] total	63.9 (8.4)	68.4 (8.5)	−3.0 (145), $p = .003$

Notes: d.f., Degrees of freedom. [a] Mullen Scales of Early Learning (Mullen 1995). [b] Autism Diagnostic Observation Schedule (Lord *et al.* 2000). [c] Vineland Adaptive Behaviour Scales — II (Sparrow *et al.* 2005).

quite apparent with some children showing a fairly typical profile of relative ability (that is, raw comprehension scores well in advance of raw production scores), but others showing the highly atypical receptive impairment (with raw comprehension only equal to raw production level). In particular, it was those children with higher non-verbal ability (who tended also to be older, and rated less severely in terms of autism symptoms) who demonstrated the atypical profile of raw vocabulary comprehension scores approaching, rather than exceeding, raw production scores. By contrast, those children retaining a more typical pattern of relatively superior receptive ability had lower non-verbal ability levels and tended also to be younger and rated more severely in terms of their autism symptoms.

An association of more advanced non-verbal skills and *atypicality* of language profile might appear counterintuitive at first glance. The explanation, however, is likely to lie in a feature of the MCDI normative scores and the operational definition of profile typicality/atypicality used here. Low-functioning children with autism often have very limited language skills, and at low levels of raw comprehension there is little room for variability in raw production. A child who understands ten words may have no speech, or may *functionally* use all of (but never more than) those ten words. Low-functioning children with autism may therefore appear to fall within the 'normal limits' of relative receptive/expressive abilities. At higher levels of raw comprehension ability, there is much room for variation in production. A child who understands 200 words may have no speech, or may functionally use all 200 words understood (as well as falling anywhere in between these extreme points). Therefore, while important and atypical language comprehension deficits may be present for many children with autism, these are probably only evident and measurable in those who have sufficient language skill to demonstrate such a receptive/expressive discrepancy. Nevertheless, it remains likely that adults may overestimate the comprehension abilities of children with good expressive skills.

The current findings, together with those from samples of children with broader diagnoses of autism and ASD (Charman *et al.* 2003, Luyster *et al.* 2008) indicate the potential role of symptom severity in the atypicality of relative receptive and expressive language abilities. No such independent contribution of symptom severity (that is, ADOS score) was found here, however, above that of non-verbal age-equivalence. Nonetheless, the current sample is unlikely to have been sufficiently heterogeneous in terms of symptom severity to demonstrate such an effect, as all met ADOS criteria for autism. This question might therefore be re-addressed in the future with a sample of children with more heterogeneous ASD diagnoses (that is, ADOS scores spanning the range of autism and autism spectrum disorder cut-offs), and with sufficient size to permit the separation of subgroups based on symptom severity and non-verbal ability.

Despite limitations imposed by the relative homogeneity of the current sample, one particular strength of the current study lies in its use of multiple language assessment measures, based on different sources of data (for a review, see Charman 2004). Confidence in the finding of atypicality in receptive/expressive language profiles is further justified by the consistency across direct assessment, parent report, and parent interview measures. However, the incorporation of multiple measures was also problematic as the specific scores obtained are not directly comparable across tests, limiting the extent to which direct comparisons could be made. Mervis and Robinson (1999) caution against comparing AE scores across measures based on different standardization samples and advocate the use of Standard Scores (SS) which yield more confidence in cross-measure comparability. However, because many children with autism score at floor level on standardized tests (Charman *et al.* 2003), such scores are often meaningless for this group (and indeed such was the case for the current sample).

This issue is further complicated by difficulties inherent in the assessment of language in toddlers and young children with ASD, as already described. Direct assessments benefit from standardized administration and experienced clinical interpretation. However, the results obtained may be misleading if children fail to 'perform' during the testing situation. Use of parent-report measures may overcome this problem, drawing upon functional language use in real world situations. However, this may introduce other biases, such as the over-reporting of a child's comprehension skills. Nevertheless, any over-reporting of raw comprehension skills by parents in the current study, would have had the effect of normalizing the association between the MCDI receptive and expressive counts, serving to reduce (rather than erroneously inflate) this effect. The multiple measures used therefore act to corroborate the pattern of findings.

A specific language atypicality often present in children with autism is the use of echoing and scripted speech; reproducing words and sentences heard by others (Tager-Flusberg *et al.* 2005). These can occur without any comprehension of what has been said, or may be used in context, indicating some degree of contextual comprehension. While echoing may make a child appear to know more words than he or she actually understands, this is unlikely to have accounted for the current results which demonstrate a relative (rather than absolute) increase in expressive language

compared with receptive ability. Additionally, MCDI completion does not ask parents to indicate receptive and expressive vocabulary, but rather receptive vocabulary (words the child 'understands') and combined receptive and expressive vocabulary (words the child 'understands and says'). Assuming sound parental insight, any word which a child echoes in the absence of comprehension would therefore be excluded on the checklist. It is true, however, that parents may assume comprehension, particularly if a child echoes within a routine and fairly appropriate context. It is possible that echoing functions as an early production mechanism through which children come to develop comprehension (based on consistent responding of the social partner). In this way, production could serve to facilitate comprehension in children with autism, whereas typically, the reverse is true; comprehension precedes and permits later production.

Implications

The current findings lead us to question the nature of the language impairment in autism, and the discrepancy between relative receptive and expressive language skills demonstrated in the current data can be considered in two ways. On the one hand, there is evidence that these children have receptive skills that are *impaired relative to* their expressive abilities. This is meaningful in pointing to comprehension as the key aspect of language impairment, something which is likely to be significant for those working to improve individual adaptive functioning (Howlin 2004). On the other hand, the current results may be considered to provide evidence of a *relative advantage* of expressive over receptive skills. This position fits with evidence for atypical language acquisition (including echolalia) in children with autism (Tager-Flusberg *et al.* 2005) and also draws attention to the presenting strengths, rather than just impairments, of these children.

However, there is a danger, particularly for these more able and expressive children, that the outward presentation of verbal competence will mislead social partners into assuming a strong foundation of comprehension skills, something which the current data show may not be justified. Parents, teachers, and clinicians interacting with a typically developing child can implicitly assume that the child understands a good deal more than he/she can say, simplifying the language they use with them, but only to a certain degree. A greater impairment in comprehension over expression means that the language used when interacting with many children with ASD should be even further simplified, relative to the child's own expressive level, if he/she is to have a chance of understanding what is being said. As the extent of receptive impairment is likely to be masked by the relatively better developed expressive skills of the child with ASD, this is a message which needs to be clearly communicated to parents and those working with these children, who may fail to appreciate fully the critical impact of such a receptive language impairment.

Such an impairment also suggests that receptive skills should be the key target for language intervention in ASD. This would hold whether an individual child presents with a fairly typical or an atypical relative receptive/expressive profile. In the latter case, where receptive skills fail to exceed production in the normal way, teaching expressive skills does not address the core language impairment of the child. In the former case, where receptive skills are appropriately advanced compared with expressive skills, continued promotion of comprehension of communication should continue to scaffold the progression of expressive abilities, as functional speech production cannot occur without underlying comprehension. Such a framework is already being applied in the formulation of various developmental pragmatics intervention approaches (for example, Drew *et al.* 2002, Aldred *et al.* 2004, and Rogers *et al.* 2006, for a review, see Rogers 2006). While scaffolding and promoting a child's functional understanding of what is said, rather than focusing primarily on teaching verbal output, is likely to be a more challenging and less immediately rewarding task for the interventionist, such an approach will focus on addressing the child's fundamental, rather than the more outwardly observable, aspects of language impairment.

Acknowledgements

We would like to thank the parents and children for their participation in this study, Rhiannon Luyster for sharing raw data from her sample of children with broader ASD diagnoses, and the following people for their assistance with data collection; Laura Blazey, Laura Brown, Nicola Burton, Sally Clifford, Mary-Jo Doyle, Kathryn Frame, Clare Holt, and Anita Mehay. This study was funded by a UK Medical Research Council Grant to the Principal Investigators of the PACT Consortium (www.medicine.manchester.ac.uk/pact/).

PACT consortium: University of Manchester - Jonathan Green (Chief Investigator), Andrew Pickles, Wendy MacDonald, Lydia White, Clare Holt, Dharmi Kapadia, Katy Bourne, Laura Blazey Stockport PCT - Tori Houghton, Carol Taylor Newcastle University - Ann Le Couteur, Anna Cutress, Sue Leach North Tyneside PCT - Sam Barron, Ruth Colmer, Sarah Randles Southwark PCT - Karen Beggs Lewisham PCT - Julia Collino King's College London - Barbara Barrett, Sarah Byford.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Notes

1. These data are presented in figure 1 along with data from the current sample.
2. Similar analysis of PLS and VABS scores also indicated around 20% of the sample to demonstrate an atypical relative receptive/expressive language pattern. However, these data were less readily interpretable than those based on the MCDI raw vocabulary counts. As such, only the latter were retained for more detailed analysis and reporting.
3. The same broad pattern of results (in subgroup mean comparisons and predictors within a logistic regression) held when children were grouped for language typicality/atypicality according to the more liberal classification of falling within/outside of the 75th percentile (Fenson *et al.* 1994) of typical receptive and expressive vocabulary association.

References

ALDRED, C., GREEN, J. and ADAMS, C., 2004, A new social communication intervention for children with autism: pilot randomised controlled treatment study suggesting effectiveness. *Journal of Child Psychology and Psychiatry*, **45**, 1420–1430.

CHARMAN, T., 2004, Matching preschool children with autism spectrum disorders and comparison children for language ability: methodological challenges. *Journal of Autism and Developmental Disorders*, **34**, 59–64.

CHARMAN, T., DREW, A., BAIRD, C. and BAIRD, G., 2003, Measuring early language development in preschool children with autism spectrum disorder using the MacArthur Communicative Development Inventory (Infant Form). *Journal of Child Language*, **30**, 213–236.

DREW, A., BAIRD, G., BARON-COHEN, S., COX, A., SLONIMS, V., WHEELWRIGHT, S., SWETTENHAM, J., BERRY, B. and CHARMAN, T., 2002, A pilot randomised controlled trial of a parent training intervention for pre-school children with autism: preliminary findings and methodological challenges. *European Child and Adolescent Psychiatry*, **11**, 266–272.

DUNN, L. M. and DUNN, L. M., 1997, *Peabody Picture Vocabulary Test*, 3rd edn (Circle Pines, MN: American Guidance Service).

FENSON, L., DALE, P. S., REZNICK, J. S., BATES, E., THAL, D. and PETHNICK, S., 1994, Variability in early communicative development. *Monographs of the Society for Research in Child Development*, **59**, 1–185.

FENSON, L., DALE, P. S., REZNICK, J. S., THAL, D., BATES, E., HARTUNG, J. P., PETHNICK, S. and REILLY, J. S., 1992, *MacArthur Communicative Development Inventories: User's Guide and Technical Manual* (Baltimore, MD: Paul H. Brookes).

HOWLIN, P., 2004, *Autism and Asperger Syndrome: Preparing for Adulthood* (Abingdon: Routledge).

KJELGAARD, M. M. and TAGER-FLUSBERG, H., 2001, An investigation of language impairment in autism: implications for genetic subgroups. *Language and Cognitive Processes*, **16**, 287–308.

KOEGEL, L. K., KOEGEL, R. L. and SMITH, A., 1997, Variables related to differences in standardised test outcomes for children with autism. *Journal of Autism and Developmental Disorders*, **27**, 233–243.

LORD, C., RISI, S., LAMBRECHT, L., COOK, E. H. Jr, LEVENTHAL, B. L., DILAVORE, P. C., PICKLES, A. and RUTTER, M., 2000, The Autism Diagnostic Observation Schedule — Generic: a standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, **30**, 205–223.

LORD, C., RUTTER, M. and LE COUTEUR, A., 1994, Autism Diagnostic Interview — Revised: a revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, **24**, 659–685.

LUYSTER, R. J., KADLEC, M. B., CARTER, A. and TAGER-FLUSBERG, H., 2008, Language assessment and development in toddlers with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, **38**, 1426–1438.

MCDUFFIE, A., YODER, P. and STONE, W., 2005, Prelinguistic predictors of vocabulary in young children with autism spectrum disorders. *Journal of Speech Language and Hearing Research*, **48**, 1080–1097.

MERVIS, C. B. and ROBINSON, B. F., 1999, Methodological issues in cross-syndrome comparisons: matching procedures, sensitivity (Se) and specificity (Sp). *Monographs of the Society for Research in Child Development*, **64**, 115–130.

MITCHELL, S., BRIAN, J., ZWAIGENBAUM, L., ROBERTS, W., SZATMARI, P., SMITH, I. and BRYSON, S., 2006, Early language and communication development of infants later diagnosed with autism spectrum disorder. *Developmental Behaviour and Paediatrics*, **27**, S69–S78.

MULLEN, B., 1995, *Mullen Scales of Early Learning* (Circle Pines, MN: American Guidance Service).

ROGERS, S. J., 2006, Evidence-based interventions for language development in young children with autism. In T. Charman and W. Stone (eds), *Social and Communication Development in Autism Spectrum Disorders* (New York, NY: Guilford), pp. 143–179.

ROGERS, S. J., HAYDEN, D., HEPBURN, S., CHARLIFUE-SMITH, R., HALL, T. and HAYES, A., 2006, Teaching young nonverbal children with autism useful speech: a pilot study of the Denver Model and PROMPT Interventions. *Journal of Autism and Developmental Disorders*, **36**, 1007–1024.

RUTTER, M., 1970, Autistic children: Infancy to adulthood. *Seminars in Psychiatry*, **2**, 435–450.

SEMEL, E., WIIG, E. H. and SECORD, W. A., 1995, *Clinical Evaluation of Language Fundamentals*, 3rd edn (San Antonio, TX: Psychological Corporation, Harcourt Brace).

SMITH, V., MIRENDA, P. and ZAIDMAN-ZAIT, A., 2007, Predictors of expressive vocabulary growth in children with autism. *Journal of Speech Language and Hearing Research*, **50**, 149–160.

SPARROW, S. S., BALLA, D. A. and CICCHETTI, D. V., 1984, *Vineland Adaptive Behaviour Scales* (Circle Pines, MN: American Guidance Service).

SPARROW, S. S., CICCHETTI, D. V. and BALLA, D. A., 2005, *Vineland Adaptive Behaviour Scales: Survey Form*, 2nd edn (Circle Pines, MN: American Guidance Service).

SZATMARI, P., BRYSON, S. E., BOYLE, M. H., STREINER, D. L. and DUKU, E., 2003, Predictors of outcome among high functioning children with autism and Asperger syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, **44**, 520–528.

TAGER-FLUSBERG, H. and CARONNA, E., 2007, Language disorders: autism and other pervasive developmental disorders. *Paediatric Clinics of North America*, **54**, 469–481.

TAGER-FLUSBERG, H., PAUL, R. and LORD, C., 2005, Language and communication in autism. In F. Volkmar, R. Paul, A. Klin and D. Cohen (eds), *Handbook of Autism and Pervasive Developmental Disorders, 3rd edn, Vol. 1: Diagnosis, Development, Neurobiology, and Behavior* (Hoboken, NJ: Wiley), pp. 335–364.

TOMASELLO, M. and MERVIS, C. B., 1994, The instrument is great, but measuring comprehension is still a problem. *Monographs of the Society for Research in Child Development*, **59**, 174–179.

VENTER, A., LORD, C. and SCHOPLER, E., 1992, A follow-up study of high-functioning autistic children. *Journal of Child Psychology and Psychiatry*, **33**, 489–507.

WILLIAMS, K. T., 1997, *Expressive Vocabulary Test* (Circle Pines, MN: American Guidance Service).

World Health Organisation (WHO), 1993, *Mental Disorders: A Glossary and Guide to their Classification in Accordance with the 10th Revision of the International Classification of Disease — Research Diagnostic Criteria: ICD-10* (Geneva: WHO).

ZIMMERMAN, I. L., STEINER, V. and POND, R. E., 1997, *Preschool Language Scales*, 3rd UK edn adapted by J. Boucher and V. Lewis (UK: Psychological Corporation).