CAN AUTISM BE PREDICTED ON THE BASIS OF INFANT SCREENING TESTS?

Mark H. Johnson
Frances Siddons
Uta Frith
John Morton

Very little is known at present about the first months of life of the autistic child. Although it is generally agreed that the origin of autism is biological and probably occurs before birth (Tsai 1989, Courchesne 1989), it is uncertain at what age the first symptoms reliably appear (see Frith 1989, Gillberg 1989). Available reports from retrospective studies tend to be equivocal: for example Dahlgren and Gillberg (1989) report some abnormalities in the first few months of life, but it is unclear whether in fact these abnormalities are specific to autism. Since autism is very commonly associated with general developmental delay, the absence of certain behaviours may not be useful for the diagnosis of autism until a later age. Delays in the same behaviours may also occur in developmentally delayed children who are not autistic.

A common criticism of retrospective studies is that the information provided is subject to problems of remembering past events with the benefit of hindsight. Prospective studies are needed to obtain a more accurate picture, but such studies are extremely difficult to carry out because of the relative scarcity of autistic disorders, *i.e.* 1 to 2 per 1000 using DSM-III criteria (American Psychiatric Association 1980). Gillberg *et al.* (1990) carried out a prospective study of children referred for developmental problems in the first three years of life. Although diagnosis of autistic disorder was possible under the age of three, this was later definitely confirmed in only three-quarters of the cases. On the other hand, the diagnosis of autism could be made with confidence for children who were 2½ years or older. This result is entirely consistent with an earlier clinical population study by Knobloch and Pasamanick (1975).

A potentially useful prospective approach is to examine as predictors the hearing and vision screening tests which are routinely applied to babies in the UK between six and 18 months of age. The tests are administered by health visitors and general practitioners. The aim of the screening, which is very brief and simple, is to alert attention to any suspected problem in development. The areas commonly covered by screening tests include motor development, visual development, hearing and social development.

We decided to search for infant screening records of children who later had been definitely diagnosed as autistic. As control groups, we searched for records of children now known to have mild or moderate learning difficulties (to the extent that they are now educated in special units), but not suffering from autistic disorder; we also collected a random sample of records for children

with no known learning disabilities or developmental problems.

Method

A letter was sent to the medical officer of every school in the UK listed in the records of the National Autistic Society, requesting that they locate the infant screening-test records of children in their care and send these to us. Unfortunately, these records were extremely difficult to locate in the absence of centralized filing systems: despite repeated efforts, we were able to obtain only 13 sets of records complete enough for use in the study. All these records came from two local-authority schools, where they had been kept. In order to qualify for entrance to these schools, the children had been diagnosed by an experienced child psychiatrist, following DSM-III criteria. As they were all currently between eight and 18 years old, their diagnosis had been amply confirmed.

Almost every screening record of the autistic sample had been completed by a different health professional and at different clinics, even though the children eventually attended the same two schools; therefore any observer bias at the screening stage is unlikely. Parental bias also is not a grave concern: first, the screening tests were carried out routinely; and second, the schooling for children with special needs was a state provision following statutory principles, rather than a private initiative. Nevertheless, it must be recognised that autistic children who receive schooling at specialist units form a non-representative subgroup of the autistic population. Finally, we guarded against investigator bias by using all the records we received and by using information only as recorded at the time of the screening in infancy.

We also obtained a sample of 19 records for children with unclassifiable developmental delay (mild or moderate learning disability) who were attending a special unit for learning-disabled children. This time we gained the help of local clinics which had kept the early records, and through them we also obtained a random sample of 'normal' infant screening-test records. The ages of the children in all groups ranged from eight to 19 years. Most of the autistic and all of the learning-disabled children also participated in concurrent experimental studies carried out by the authors, and had received a detailed assessment using the Vineland Adaptive Behaviour Scales. Therefore, it was possible to ascertain that the learning-disabled group had none of the social impairments typical of autism, while the autistic children all had characteristic social impairments—albeit to varying degrees.

We tried to equate the three samples for geographical area and socio-economic status. The majority of the records for the learning-disabled and normal children came from the same mixed neighbourhood in Kent; although the autistic children were drawn from a much wider area, all but two came from the south-east of England. All socio-economic classes were represented, without bias towards the middle-class. The autistic children's British Picture Vocabulary Scales verbal IQs ranged between 40 and 61; those of the learning-disabled group were between 54 and 81, and those of the normal children between 94 and 108. The greater degree of retardation among the autistic group might have introduced a bias toward earlier detection than might be expected for mildly learning-disabled children.

Coding

The infant screening-test records varied in format according to the particular Health Board concerned. However, all of those used in the final sample could be coded according to whether or not the infant had normal development in the following categories: motor, vision, hearing and language, and social. For some children, we obtained several screening records (approximately every six months) between six and 18 months; for others, information was available at only one or two age-points within that period. Information from earlier or later points was recorded for very few of the infants.

An infant was classified as having problems in a category if one or more of the following basic criteria were met: (1) referral to a specialist, (2) a note had been made to re-check the test at a later date, or (3) a note had been made that the infant

TABLE 1
Incidence of 'problems'* recorded in screening tests of as-yet undiagnosed infants: reported frequencies of available total

Diagnosis now	*Areas targeted by screening test*			
	Motor	*Vision*	*Hearing*	*Social*
At 6 months				
Autistic	1/10	1/10	3/10	0/9
Mildly learning-disabled	3/14	2/14	1/13	0/14
Normal	1/19	0/19	5/18	0/19
At 12 months				
Autistic	1/7	0/7	1/8	1/6
Mildly learning-disabled	4/5	2/6	2/4	3/5
Normal	1/3	0/3	0/3	0/3
At 18 months				
Autistic	2/7	0/7	1/7	4/7
Mildly learning-disabled	7/17	2/17	10/17	4/15
Normal	0/11	1/10	1/10	0/10

*See text for definitions.

appeared unusual in a particular respect. This categorisation does not distinguish between degrees of problems. Each infant was reconsidered at six, 12 and 18 months, as available. The records were coded completely independently by three assessors. Because of the clarity of the coding scheme, there were very few discrepancies between assessors; the few that did occur were resolved by an assessor blind to the categories of the records.

Results

Table I shows the number of occasions on which a problem had been recorded on the screening form for each of the four categories at six, 12 and 18 months, respectively.

χ^2 tests were run on the six- and 18-month-old age-groups to ascertain whether the autistic, learning-disabled and normal groups showed significantly different frequencies of detection of problems for any of the categories at any age. The only statistically significant effects were at the 18-month test for the categories social ($\chi^2 = 7{\cdot}2$, $p = 0{\cdot}027$) and hearing and language ($\chi^2 = 8{\cdot}3$, $p = 0{\cdot}016$); the motor category at 18 months approached significance ($\chi^2 = 5{\cdot}97$, $p = 0{\cdot}051$). There were insufficient sample sizes at the 12-month test to allow statistical testing.

Discussion

At six months, no statistically significant differences in reported problems were evident between the groups. However, reports of motor and vision problems were slightly more frequent for the learning-disabled than for the other groups. All groups contained some infants with reports of hearing problems (between 7 and 30 per cent), but none had problems noted at that stage under the social category. The general rates of occurrence of reported abnormalities was surprisingly low. The actual rates of referral to a specialist or general practitioner (when the test was administered by a health visitor) were well under half the frequencies of problems quoted; usually a problem was recorded as a note to re-check an item at a later date or at the next testing age. Despite this, there was still a very low rate of reported abnormalities, which may well be due to the poor sensitivity of the tests at this age rather than to the absence of symptoms. Nevertheless, the lack of any evidence for concern about social developmental problems in the autistic group (which might have included lack of smiling or lack of responsiveness to people) at this age is striking.

At 12 months, problems were reported more frequently in all categories for the mildly learning-disabled group. Despite relatively small sample sizes, this substantive increase suggests that the sensitivity of screening tests at this age is improved. For the autistic sample, the incidence of reported problems remained very low: no more than one case in any category. It is possible that this low rate of detection reflects a genuine paucity of symptoms at this age. These results are consistent with some of the evidence from studies in which examination of home movies of infants later diagnosed as autistic revealed no specific abnormalities in early infancy (Lösche 1990, but see Adrien *et al.* 1991).

By 18 months, the normal group yielded uniformly low frequencies of problems: up to 10 per cent. Rates of reported abnormality for the learning-disabled group remained high in all categories (from 12 per cent in vision to 59 per cent in the hearing and language categories). In contrast, the autistic sample had a high frequency of problems specifically in the social category (57 per cent); otherwise only the motor category contained more than one reported case of abnormality. This pattern is consistent with the hypothesis of a specific developmental delay in the social domain, with detectable onset by simple routine screening between 12 and 18 months.

Accepted for publication 12th November 1991.

Acknowledgements
We thank the staff of Heathlands School, Lancaster Autistic Unit, and Ramsden Junior School and Special Unit for their assistance. We also thank Dr. Suzanne Dziurawiec, Dr. Helen Wesley, Mrs. Gillian Stotten, Mrs. Barbara Castle and David Bossano for their help with the screening records.

Authors' Appointments
*Mark H. Johnson;
Frances Siddons;
Uta Frith;
John Morton;
MRC Cognitive Development Unit, 17 Gordon Street, London WC1H 0AH.

**Correspondence to first author* at Department of Psychology, Carnegie Mellon University, Pittsburgh, PA 15213-3890.

SUMMARY
The authors examined infant hearing and vision screening tests for a group of children subsequently diagnosed as autistic and compared them with a group of children suffering from non-specific developmental delay, as well as with a random sample of records. Four categories (motor, vision, hearing and language, social) were investigated at three ages: six, 12 and 18 months. The random sample group had a low incidence of reported problems at all ages. The learning-disabled group had a sharp increase in reported abnormalities in all categories at 12 months. The autistic group had a selective increase in the social category alone at 18 months.

RÉSUMÉ
L'autisme peut-il être prédit à partir de tests de dépistage chez le nourrisson?
Les auteurs ont analysé les résultats de tests de dépistage d'audition et de vision dans un groupe d'enfants chez qui un diagnostic d'autisme avait été porté ultérieurement, et les ont comparés à ceux d'un groupe d'enfants présentant des retards de développement non spécifiques, ainsi qu'à un échantillon aléatoire de dossiers. Quatre catégories (motricité, vision, audition et langage, socialisation) ont été appréciées aux âges de six, 12 et 18 mois. L'échantillon aléatoire présentait une faible incidence de problèmes préciés, à tous les âges. Les enfants présentant des difficultés d'apprentissage présentaient une augmentation importante des anomalies précisées dans toutes les catégories à 12 mois. Le groupe autistique présentait un accroissement isolé dans les items de socialisation à 18 mois.

ZUSAMMENFASSUNG
Kann Autismus durch Screening Tests beim Säugling vorausgesagt werden?
Die Autoren untersuchten die Screening Hör- und Sehtests von Kindern, bei denen später die Diagnose Autismus gestellt wurde, und verglichen sie mit einer Gruppe von Kindern, die eine unspezifische Entwicklungsverzögerung hatten, sowie mit einigen willkürlich herausgegriffenen Fällen. Vier Parameter (Motorik, Sehvermögen, Hörvermögen und Sprache, Sozialverhalten) wurden in drei Altersstufen untersucht: mit sechs, 12 und 18 Monaten. Die nach dem Zufallsprinzip herausgegriffene Gruppe hatte in allen Altersstufen wening Probleme. Die lernbehinderte Gruppe hatte mit 12 Monaten eine starke Zunahme der angegebenen Anomalien bei allen Parametern. Die autistische Gruppe hatte nur mit 18 Monaten einen selektiven Anstieg in der Kategorie Sozialverhalten.

RESUMEN
Puede predecirse el autismo sobre la base de los tests de barrido en el lactante?
Los autores examinaron las pruebas de barrido auditivas y visuales en un grupo de niños subsiguientemente diagnosticados de autísticos, y los compararon con un grupo de niños que padecían un retraso de desarrollo no específico, así como con los datos de una muestra al azar. Se investigaron cuatro categorías (motor, visión, audición y lenguaje, social) a tres edades: seis, 12 y 18 meses. La muestra al azar tenía una baja incidencia de los problemas estudiados en todas las edades. El grupo con alteración del aprendizaje tenía un aumento intenso de las anomalías estudiadas en todas las categorías a los 12 meses. El grupo autístico tenía un aumento selectivo sólo en la categoría social a los 18 meses.

References

Adrien, J. L., Faure, M., Perrot, A., Harneury, L., Garreau, B., Barthelemy, C., Sauvage, D. (1991) 'Autism and family home movies: preliminary finding.' *Journal of Autism and Developmental Disorders,* **21,** 43–50.

American Psychiatric Association (1980) *Diagnostic and Statistical Manual of Mental Disorders, 3rd Edn (DSM-III).* Washington: APA.

Courchesne, E. (1989) 'Neuroanatomical systems involved in infantile autism: the implications of cerebellar abnormalities.' *In* Dawson, G. (Ed.) *Autism: Nature, Diagnosis and Treatment.'* New York: Guilford Press.

Dahlgren, S. O., Gillberg, C. (1989) 'Symptoms in the first two years of life. A preliminary population study of infantile autism.' *European Archives of Psychiatry and Neurological Science,* **238,** 169–174.

Frith, U. (1989) *Autism: Explaining the Enigma.* Oxford: Blackwell.

Gillberg, C. (1989) 'Early symptoms in autism.' *In* Gillberg, C. (Ed.) *Diagnosis and Treatment of Autism.* New York: Plenum Press.

— Ehlers, S., Schaumann, H., Jakobsson, G., Dahlgren, S. O., Lindblom, R., Bågenholm, A., Tjuus, T., Blidner, E. (1990) 'Autism under age 3 years: a clinical study of 28 cases referred for autistic symptoms in infancy.' *Journal of Child Psychology and Psychiatry,* **31,** 921–934.

Knobloch, H., Pasamanick, B. (1975) 'Some etiologic and prognostic factors in early infantile autism and psychosis.' *Pediatrics,* **55,** 182–191.

Lösche, G. (1990) 'Sensorimotor and action development in autistic children from infancy to early childhood.' *Journal of Child Psychology and Psychiatry,* **31,** 749–761.

Tsai, L. (1989) 'Recent neurobiological findings in autism.' *In* Gillberg, C. (Ed.) *Diagnosis and Treatment of Autism.* New York: Plenum Press.