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One-year Change in Repetitive Behaviours in Young Children with Communication Disorders Including Autism

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Abstract Repetitive behaviours are a relatively neglected area of study in autism. Previous research has concluded that repetitive behaviour is inversely related to ability and that it tends to increase over the preschool years. One-hundred and four children ages 24–48 months, with autism, autism spectrum disorder (ASD) or other disorders, were followed for 13 months. Twelve items from the Autism Diagnostic Interview (ADI-R) were analysed, as well as diagnostic algorithm scores. Ability was related to degree of repetitive behaviours, except for one cluster of relatively able children. ADI-R repetitive behaviour algorithm scores increased over time; however, when all 12 behaviours were considered, there was a general decrease in impact upon the child's and family's activities. Reasons for this decrease are discussed.

Keywords Longitudinal · Repetitive behaviour · Autism spectrum disorder · Ability · Early identification · ADI-R

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Introduction

Early Identification of Autism

Parents of children with autism may be aware of problems in their child's development in early infancy (Baird et al., 2001). Retrospective evidence from parental interviews, early video tapes, and health worker reports suggests that by 18 months, and possibly as early as 12 months, many children with autism show a distinct pattern of impairments in comparison to other typically developing and developmentally delayed children (Bailey, Philips & Rutter, 1996; Baranek 1999; Charman, 2000; Young, Brewer, & Pattison, 2003). Despite evidence of problems in preschool years there remains a considerable delay in diagnosis particularly in those children who receive a diagnosis of autism spectrum disorder (ASD) rather than core autism (Baird et al., 2001; Howlin & Moore, 1997; Howlin & Asgharian, 1999). The age at which ASDs are diagnosed has both practical and theoretical implications. Outcome (Baird et al., 2001), access to services (Cox et al., 1999), and understanding of the precursors of autism (Lord, 1995) are all affected. Recently there has been an increased effort towards early identification (Baird et al., 2001; Charman & Baird, 2002; Filipek et al., 1999; Le Couteur, 2003).

Baron-Cohen, Allen, and Gillberg (1992) proposed that autism could be detected at 18 months using the Checklist for Autism in Toddlers (CHAT), which assesses simple pretend play and joint attention behaviours through parental report and health practitioner observation. When applied to general (Baird et al., 2000) and referred populations (Robins, Fein, Barton, & Green, 2001), evidence suggests some cases

of autism can be identified at 18 months using the CHAT, through the child lacking certain key behaviours. However, when the general population was followed up at 7 years, 50 children were diagnosed with autism, of whom only 10 had been identified at 18 months (Baird et al., 2000). Ideally, if early diagnosis is to be successful and stable, early markers of ASD must be established and accurately defined. These may include both unusual features in behaviour (e.g. avoidance of eye contact and resisting cuddles) and also lack of key behaviours (such as failing to point for interest). The markers may be abnormal, that is, not usually seen in normal development (e.g. sniffing everything), or instead indicate a delay in the usual patterns of progression (e.g. only gradually becoming more cooperative and having fewer tantrums). Nevertheless, the distinctions to be made may be subtle given the normal range of variability in infant development.

Repetitive behaviours are a core component of the diagnosis of autism. They potentially form an important part of early identification; however little is known about early repetitive behaviour problems (Lewis & Bodfish, 1998; Turner, 1999). They are evident in some children from an early age, their presence noticed prior to development of language both in the typical population and in the developmentally delayed. Though not endorsed in the categorisations laid out in ICD-10 and DSMIV, Wing and Gould (1979) identify repetitive behaviours as the reflection of imaginative impairments. Since lack of pretend play is one indicator of early autism (e.g. in the CHAT) this suggests that close examination of specific attributes of repetitive behaviour in young children with ASD may highlight potential early markers of disorder.

Repetitive Behaviours

ICD-10 requires ''restricted, repetitive and stereotyped patterns of behaviour, interests, and activities'' for a diagnosis of autism. Repetitive behaviours however are not exclusive to autism, and are present in typical and other atypical populations (Berkson & Tupa, 2000; Bodfish, Sumons, Parker, & Lewis, 2000; Evans et al., 1997; Lewis & Bodfish, 1998; Turner, 1999). While sharing qualities of invariance, inappropriateness, repetition and rigidity (Turner, 1999), repetitive behaviours are manifest in autism and ASD in a number of ways including both 'lower-level' behaviours such as sensory preoccupations, motor mannerisms, self-injury, compulsions, and 'higher-level' behaviours such as circumscribed interests, repetitive use of language and an insistence on sameness (Bodfish et al., 2000; Lewis & Bodfish, 1998; Turner, 1996, 1999). ICD-10 identifies four categories of repetitive behaviour, at least one of which must be present for a diagnosis of autism: (a) encompassing preoccupations or circumscribed pattern of interests, (b) apparently compulsive adherence to non-functional routines or rituals, (c) stereotyped and repetitive motor mannerisms and (d) preoccupations with part-objects or non-functional elements of materials.

Repetitive Behaviours in Normal Development

An important feature of typical development, repetitive behaviour is seen throughout childhood. During their first year of life, infants demonstrate a large amount and variety of rhythmical and stereotyped behaviours including kicking, waving, banging, twirling, bouncing and rocking (Thelan, 1979). These behaviours reduce after 12 months. Around 24–36 months of age, compulsive like behaviours including preference for sameness and compulsions begin to emerge (Evans et al., 1997). Such changes in the form of repetitive behaviours are noted to be a result of cognitive and emotional maturation. They serve functions such as enhanced learning through repetition, and lowering anxiety through predictability of routine. Maturation results in a decrease in all repetitive behaviours around the age of 4 years. By the time a typical child reaches school age there are usually relatively few repetitive behaviours to be seen (Berkson & Tupa, 2000). Repetitive behaviours such as nail biting, pacing and keenly pursued hobbies remain in the repertoires of some individuals (Frith, 1999); however these behaviours are not thought to be pathological, distinguishing them from behaviours (e.g. hand flapping or unusual sensory interests) seen in clinical populations such as children with autism, intellectual impairment or severe visual impairment.

Repetitive Behaviours in Autism

The amount and frequency of repetitive behaviours seen in autism is significantly higher than that seen in the typical population (Bodfish et al., 2000). Differences in the types of repetitive behaviour demonstrated in autism and typical development are also evident. Young children with autism are more likely to engage in body rocking, finger flicking and hand flapping (Abelson, 1983) and mouthing and unusual posturing (Baranek, 1999) than their typical peers. Furthermore some aspects of repetitive behaviour discriminate between children with autism and those with general developmental delay at 2–3 years of age, particularly hand and finger mannerisms and unusual

sensory interests (Lord, 1995). Different types of repetitive behaviour may have differing underlying causes and maintaining factors. For example, self-stimulating behaviours may arise from boredom and inability to generate new activities; others such as hand flapping may be associated with over-arousal or excitement (Hall, Thorns, & Oliver, 2003). Special interests and some obsessions seem to reflect a particular cognitive style in more able children with ASD, while other behaviours such as pacing or repetitive questions may indicate heightened anxiety (Turner, 1999).

Repetitive Behaviours and Age

Repetitive and stereotyped behaviours in autism change in amount and pattern with age. They are found to be less consistent in the second and third years of life than at 4–5 years (e.g. Cox et al., 1999; Stone et al., 1999). Moore and Goodson (2003) examined children referred because of interaction and communication difficulties at 2 years and re-assessed them at 4–5 years. Social and communication skills were found to change very little over time, whilst repetitive behaviours were subject to age related changes, becoming more apparent as time went on. In Kanner's original description of children with autism he noted that by 5–6 years, ''the repetitiousness assumes the form of obsessive preoccupations.'' Similar changes in the most prominent behavioural characteristics of autism have been reported by others, particularly a reduction in complex mannerisms and an increase in circumscribed or unusual interests (Lord, 1995; Moore & Goodson, 2003).

Repetitive Behaviours and Ability

Evidence suggests that developmental level is related to the degree and type of repetitive behaviours manifested. Berkson and Tupa (2000) note that negative correlations have been found between IQ and repetitive behaviours in severely developmentally delayed populations. Furthermore, repetitive behaviours may be less common in young or severely developmentally delayed children as a result of the required cognitive sophistication, for example, to notice changes or to plan and anticipate the performance of a ritual (Gray & Tonge, 2001; Szatmari et al., 2000). Many studies subdivide children into predefined groups according to intellectual functioning or specific abilities. However, to validate findings on repetitive behaviour and their universality to the ASD population, it is important to account for varying symptomatology. Behavioural profiles need to be set against a child's overall developmental level for strong indicators or markers of autism to be identified (Charman, 2000).

Examination of cognitive-behavioural links in children with related disorders, such as language disorder, are very relevant for autism research (Bailey et al., 1996). Indeed, language disorders and autism may represent differences along a dimension (Bishop, 2000; Howlin, Mawhood, & Rutter, 2000) and at times children may be difficult to distinguish clinically (Wing, 1996). It is reported by Paul and Cohen (1984) that 50% of those with language delays show autistic symptoms including language and communication abnormalities and social withdrawal. Michelotti, Slonims, Baird, and Charman (2002) followed up a group of children referred in preschool years because of concerns that they might have autism, but for whom it was concluded that they had a primary language problem. At follow-up when the children were seen in mid-childhood, the clinical picture of language problems had improved but repetitive behaviours remained present in a number of forms. Thus, contrary to expectation, as language improved, the features which had caused concern had not disappeared. Rather the children went on to meet criteria for atypical autism. Howlin, Mawhood, and Rutter (2000) conducted a 20-year follow up of individuals with either autism or developmental receptive language disorders, recruited at 7–8 years (Bartak, Rutter, & Cox, 1975). At 7–8 years and in early adulthood, individuals with autism were reported to engage in significantly more stereotyped behaviours. However, many in the language disordered group did develop interests and routinised behaviour patterns over time. Therefore, there is good reason to study repetitive behaviour in language delayed or disordered children, to understand similarities or differences in patterns of change from groups of children with ASD.

Measurement of Repetitive Behaviours

Many of the studies of repetitive behaviours cited above have used a 'gold standard' diagnostic tool, the Autism Diagnostic Inventory (ADI-R), which gathers detailed information about behaviour in a range of situations through parental interview (Le Couteur, Rutter, & Lord 2003; Lord, Rutter, & Le Couteur 1994). Parents' responses are rated on impact and degree of abnormality of the behaviours described, and algorithm scores for a selection of the interview items are calculated for social, communication and repetitive behaviours. However, in order to examine repetitive behaviours in detail it is likely to be important to go beyond the algorithm, using a wider range of items

appropriate to the population being researched. The few longitudinal studies of repetitive behaviour (Howlin et al., 2000, McGovern & Sigman, 2005; Piven, Harper, Palmer, & Arndt, 1996) have examined changes reported in the ADI-R over a long period of time such as from preschool to adulthood, looking at outcomes rather than developmental changes. To understand typical and atypical development and prognosis, and aid in the early differentiation of developmental disorders, examination of developmental changes over a limited time period are essential (Charman et al., 2005).

The literature raises a number of questions. Can repetitive behaviours act as markers for early identification of ASD? Do repetitive behaviours increase with age in preschool children with ASD? If so, does the relationship between repetitive behaviours and ability hold in young children? Do repetitive behaviours differ in severity and type along a dimension of communication disorders? Finally, does the ADI-R adequately measure repetitive behaviours in young children?

To address these questions, we will examine repetitive behaviours in a large cohort of 2 to 4 year old children with ASD and speech and language delays, and track developmental changes over a 13 month period. This will not only identify differences between groups at an early age but also how subgroups of children differ over time.

The study tests the following specific hypotheses:

1. Repetitive behaviour items from the ADI-R will group into four factors as identified in ICD-10.
2. Children with better ability will have fewer repetitive behaviours than those children with lesser ability.
3. Children with better ability will demonstrate a different pattern of repetitive behaviours from children with lesser ability.
4. Repetitive behaviours will increase over time in children with ASD.

Method

Subjects

A cohort of 104 preschool children was recruited between 24 and 48 months of age from community health sources. All the children took part in one of two studies. Study 1: Forty-six children with ASD or language disorder were recruited for a study of precursors of executive dysfunction (Shearer, 2001). Study 2: Fifty-eight children with suspected or diagnosed ASD were recruited for a systematic evaluation of a group parent training intervention (McConachie, Randle, Hammal, & Le Couteur, 2005). The studies took place in North East England.

Inclusion criteria in both studies were the presence of complex social and/or communication difficulties which may be indicative of an autism spectrum disorder; therefore some children did not have a clinical diagnosis at recruitment. For study 1, children with specific language delay/disorder were also recruited; both groups of children in study 1 had reached the stage of producing at least single words prior to recruitment, and they did not have severe global developmental delay. Exclusion criteria for both studies were the presence of severe birth complications or other diagnosable severe organic medical disorder.

Of the 104 children, 89 were followed up at Time 2 (see Table 1). In study 2, three children were not followed up as their parents did not attend the group parent training intervention, and one began an intensive intervention. Of the seven who withdrew from the research studies, reasons given included its being too stressful for the child, or for the mother, or that the child was progressing well. The diagnostic categories in Table 1 are a 'best estimate' clinical diagnosis (see below).

Measures

Diagnostic Grouping

A best estimate clinical diagnosis was developed by the senior authors (HM, ALC) drawing on all available clinical information, and including the ADI-R and all Time 1 research assessment information. This included direct assessment with the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000). ADOS tapes were viewed to clarify ambiguity and reach consensus. The children were grouped as 'Autism' where they met all ICD10 criteria for a diagnosis, and 'ASD' where the diagnosis was more likely to be under another heading of pervasive developmental disorder. All these children had significant social, communication or behaviour abnormalities identified in their development before 36 months of age. Children defined as 'Other' had specific speech or language difficulties (22), probable hyperactivity disorder (2) or apparently normal development after evaluation (1).

Ability

The Mullen Scales of Early Learning (Mullen, 1995) are a direct standardised assessment of children's

Table 1 Child characteristics at time 1 and time 2, and reasons for loss to followup

	N	Age range (months)	Mean age (sd)	Autism (boys)	ASD (boys)	Other (boys)
Time 1	104	24–48	37.05 (6.08)	51 (43)	28 (22)	25 (18)
Time 2	89	35–67	50.15 (6.71)			
Reasons	15					
Moved away				2	0	2
Not followed				4	0	0
Parents withdrew				4	1	2

abilities and are used in many studies of preschool children with ASD or other developmental disorder (e.g. Lord, Shulman, & DiLavore, 2004). Two of the subscales are reported here: Receptive Language and Expressive Language raw scores at Time 1.

The Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984) is a parent interview about the child's abilities in socialisation, communication, daily living skills and motor skills. In this study, the Time 1 standard scores for communication and socialisation are reported (cf. Charman et al., 2005), averaged to create a composite score, with mean of 100 (sd 15).

Repetitive Behaviours

The detailed study of repetitive behaviour was based upon selection of 12 items from the Autism Diagnostic Interview (ADI-R) (Lord et al., 1994). Moore and Goodson (2003) used only items included in the scoring algorithm for repetitive behaviour; additional items were selected for the present study which applied to preschool children. 'Circumscribed interests' was excluded from analysis as the ADI-R item is not applicable to children below 4 years of age. 'Verbal rituals' was not included as few children in the cohort had phrase speech and therefore the item was not rated (it was included, where rated, in calculation of the ADI-R algorithm score). 'Repetitive use of language', whilst included by Piven et al. (1996), was also not included in the present analysis as many children had insufficient verbal abilities. Each item is rated on a 4-point scale (0–3) in terms of the degree of intrusion into or constraint upon the child's or family's activities (Unusual sensory interests are rated 0–2). In order to measure change, the rating of 'current' behaviour was taken, that is, reflecting the child's behaviour in the previous three months. (Nb. the 'ever' rating is used in calculating a diagnostic algorithm score.) The total score range was 0–35 (see Table 2)

Procedure

The studies were approved by the Northern and Yorkshire Multi-centre Regional Ethical Committee, and all relevant Local Ethics Committees. Community paediatricians and speech and language therapists in the North East of England were asked to obtain informed consent from parents of young children who met the inclusion criteria to participate in one of the studies. In each of the studies, the research assessments were carried out in the children's homes by the same developmental psychologist (HS, VR) at both time points (except four at Time 1 done by HM). The same research diagnostic and ability assessments were used at Time 1 and at follow-up one year later (Time 2).

Analysis

To allow detailed examination of behavioural profiles and changes over time, principal components analysis of the 12 repetitive behaviour items was conducted. Paired *t*-tests were conducted on total and component scores, and on ADI-R algorithm scores, to examine the significance of changes over time. Pearson's correlations were conducted between repetitive behaviour scores and ability measures.

Hierarchical cluster analysis, using Wards method and the squared Euclidean distance, was performed on Time 1 repetitive behaviour data, to examine which children had similar patterns of repetitive behaviours.

Table 2 The 12 ADI-R items included in the analysis of repetitive behaviours

Behaviour
Unusual preoccupations*
Repetitive use of objects*
Difficulties with minor changes
Resistance to change
Compulsions/rituals*
Unusual attachment to objects
Unusual sensory interests*
Abnormal idiosyncratic responses
Unusual fears
Hand and finger mannerisms*
Complex mannerisms/stereotyped movements*
Self-injury

* ADI-R repetitive behaviour algorithm items (nb. 'circumscribed interests' not included for children less than 4 years; 'verbal rituals' not included because of high proportion of children without phrase speech)

Results

At Time 1 104 children were recruited and assessed, with 101 having a complete ADI-R conducted with parents. At Time 2, 84 ADI-Rs were conducted. There was no difference in total repetitive behaviour scores at Time 1 (on the twelve selected ADI-R items) between children who did not have a follow-up ADI-R and those who did ($t = -.06$, $p > .05$). At Time 1 children with a best estimate diagnosis of Autism had significantly greater levels of repetitive behaviours than children with ASD (mean 12.47 (sd 5.90), mean 7.32 (sd 4.32) respectively, $t = 4.04$, $p < .001$) and than children with an 'Other' diagnosis (mean 1.54 (sd 1.64), $t = 12.05$, $p < .001$).

Hypothesis 1: Groupings of Repetitive Behaviours

Principal components analysis using direct oblimin rotation to allow for correlations between items revealed three components with eigenvalues above 1 (see Table 3, which lists items loading over .4). Each component represents a different grouping of repetitive behaviours, and appears to match ICD-10 domains. The exception is 'unusual fears' which appears in two components. This may reflect the underlying natural history of unusual fears, either as a response to sensory stimuli or to experiencing change.

It was hypothesised that ICD-10 repetitive behaviour domains would be replicated in the principal components analysis of ADI-R items, and inspection shows that this is mostly supported. Component 2 represents the characteristics of ICD10 category b (apparent compulsive adherence to non functional routines/rituals), Component 3 represents ICD-10 category a (encompassing preoccupation or circumscribed pattern of interest) and Component 1 represents categories c and d (stereotyped and repetitive motor mannerisms, and preoccupations with part-objects or non-functional elements of materials).

Hypotheses 2: Relationship with Ability

Children with better ability did, as hypothesised, have fewer repetitive behaviours (see Table 4). However, this relationship did not hold so clearly for spoken language as the children got older.

Hypothesis 3: Patterns of Repetitive Behaviours

In order to look further at individual differences, cluster analysis was used on the ADI-R items, revealing a four-group solution. Examination of repetitive behaviour profiles for each group of children revealed clear between group differences in the mean scores for each item and overall profile of behaviours. Table 5 reports the make up of each cluster including total repetitive behaviour scores, raw scores for Mullen expressive and receptive language, Vineland communication and socialisation composite, and best estimate clinical diagnosis.

Only Cluster 4 represents entirely one clinical group, children with core autism and learning disability. All the children categorised as 'Other' are included in Cluster 1; however, this cluster also includes some individuals with autism and ASD. Cluster 1 had the lowest mean total repetitive behaviour score and the highest mean score for receptive language and adaptive behaviour. The children in Cluster 4 have the highest mean total repetitive behaviour and the lowest mean receptive, expressive language and adaptive behaviour scores. Cluster 3 reports the highest mean expressive language score and a similarly high receptive language score; this group is made up of almost equal percentages of children with autism and ASD and reports a mid-range level of repetitive behaviours. It should be noted that Cluster 3 has a much higher standard deviation for language measures than other clusters, suggesting a large amount of within-group variation. Cluster 2 is primarily made up of children with autism; this group reports relatively poor

Table 3 Principal components analysis of repetitive behaviour items

Component 1 (Sensory Motor/ICD-10 c & d)	Component 2 (Resistance/ICD-10 b)	Component 3 (Interests/ICD-10 a)
Repetitive use of objects	Difficulties with minor changes	Unusual preoccupations
Unusual sensory interests	Compulsions/rituals	Unusual attachment to objects
Unusual fears	Resistance to change	
Hand & finger mannerisms	Unusual fears	
Complex/stereotyped movements	Abnormal idiosyncratic responses	
Self-injury		

Table 4 Correlations of total repetitive behaviours and ability

Total repetitive behaviours	Mullen Receptive language	Mullen Expressive language	Vineland communication	Vineland socialisation
Time 1	–.486**	–.323**	–.436**	–.507**
Time 2	–.409**	–.205	–.279*	–.411**

** correlation is significant at the .01 level; * correlation is significant at the .05 level

expressive and receptive language scores, yet mean total repetitive behaviours are low.

In summary, Cluster 1 contains children demonstrating very few repetitive behaviours and relatively good expressive, receptive language and communication and socialisation skills. Many of the children have a clinical diagnosis of specific speech and/or language disorder. Clusters 2 and 4 represent mostly children with core autism, with limited abilities, who differ in terms of the degree of repetitive behaviours. Cluster 3 represents those children with relatively good verbal ability and communication and socialisation skills, who nevertheless have a significant degree of repetitive behaviours.

Examination of the components of behaviours in each cluster provides further detail of between-group differences. Composite scores for Sensory motor, Resistance and Interests were created for each individual by summing current scores for each item within a component, and dividing by the number of items in that component. Each component score thus had a possible range of 0–3. Figure 1 shows mean composite scores for each component of repetitive behaviours at Time 1 and Time 2 for each cluster.

Children in clusters 1, 2 and 4 had more Sensory motor behaviours at Time 1 than any other component. Cluster 3, who had relatively greater ability as well as prominent repetitive behaviours, had slightly more Resistance related behaviours. The least prominent type of repetitive behaviour for all clusters is Interests in this cohort of 2 to 3 year olds.

Hypothesis 4: Developmental Changes

Changes in total repetitive behaviour were examined for each cluster of children. All clusters showed some decrease in total repetitive behaviours over time; however only the 7 children in Cluster 4 ($t = 2.73$, $p < .05$) showed a significant decrease. At Time 2, it is clear that repetitive behaviour profiles for clusters 2, 3 and 4 are becoming more similar. Over time, clusters 1 and 4 tended to decrease in mean scores for all components. Cluster 2 reported a decrease in Interests and a tendency to increase in Sensory motor and Resistance behaviours, whilst Cluster 3 reported the opposite pattern of a tendency to decrease in Sensory motor and Resistance behaviours and increase in Interests. Paired *t*-tests reveal that the statistically significant changes seen in repetitive behaviours are for Cluster 2 decrease in interests ($t = 2.63$, $p < .05$), and for Cluster 4 decrease in Sensory motor behaviours, ($t = 3.06, p < .05$).

In order to compare this cohort with previous studies, ADI-R algorithm scores were computed at Time 1 and Time 2 (see Table 6). Paired t-tests showed generally a stable pattern, with the exception of the children who have a best estimate diagnosis of ASD. Both their unusual patterns of social interaction, and their repetitive behaviour scores, increased significantly across the 13 month interval.

Early Identification?

By examining the percentage of children who score above 0 for each item it is possible to determine whether there are some repetitive behaviours which may be specific to autism or ASD. There was a total absence of 'resistance to change' and 'abnormal idiosyncratic behaviours' at Time 1 within the 'Other' group. Note that this does not necessarily mean that all children with autism or ASD will display such behaviours. At Time 1 over 90% of children with autism, 65% of children with ASD but only 21% of children with an 'Other' diagnosis report a score of 1 or more for 'repetitive use of objects'. No child with an 'Other' diagnosis scored over 1 for any repetitive behaviour, with the exception of 'unusual sensory interests', where one child had a score of 2.

Discussion

This research has examined the developmental changes in repetitive behaviours in a large cohort of young

Table 5 Cluster profiles for repetitive behaviours at time 1

Cluster	Autism	ASD	Other	Total RB mean (sd)	Expressive language mean (sd)	Receptive language mean (sd)	Vineland (communication & socialisation) mean (sd)
1	4	11	24	2.39 (2.31)	20.56 (6.44)	24.24 (6.30)	76.56 (12.86)
2	27	9	0	10.50 (4.18)	15.39 (5.61)	16.84 (5.25)	62.69 (9.80)
3	11	8	0	12.06 (3.50)	22.39 (8.42)	23.17 (8.17)	69.76 (12.27)
4	7	0	0	22.00 (3.27)	12.14 (2.27)	13.86 (3.53)	58.57 (6.02)

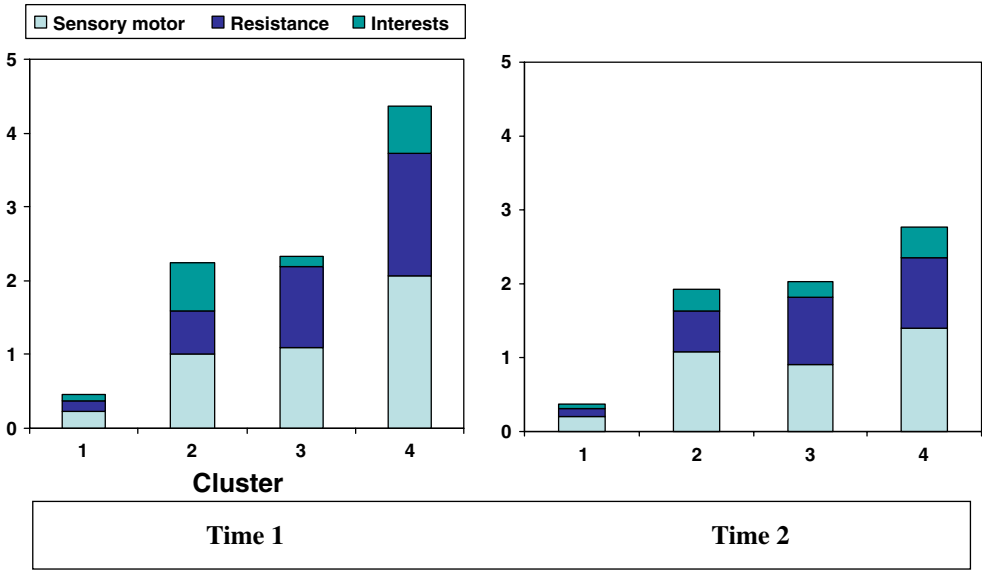

Fig. 1 Repetitive behaviour component scores at times 1 and 2

Table 6 Comparison of ADI-R algorithm scores at time 1 and time 2

	Social interaction			Communication			Repetitive behaviours		
	mean (sd) time			mean (sd) time			mean (sd) time		
	1	2	*t*	1	2	*t*	1	2	*t*
Autism	17.92 (4.96)	18.73 (6.24)	–.90	10.81 (3.13)	11.46 (3.22)	–1.12	5.30 (1.31)	5.76 (1.75)	–1.70
ASD	7.96 (5.46)	10.68 (5.87)	–2.19*	6.36 (3.37)	6.96 (3.45)	–.92	3.72(2.35)	5.20 (2.69)	–5.02**
Other	2.00 (1.92)	1.20 (1.51)	1.37	3.40 (3.10)	2.55 (2.61)	1.06	1.25 (1.21)	1.45 (1.61)	–.81

* $p < .05$, ** $p < .01$

children with autism and speech and language delays over a 1-year period, aiming to identify specific behaviour profiles and the ways in which they change over time. The main findings are that:

a) three groupings of repetitive behaviour can be identified within the 12 selected ADI-R items, which map on to the four domains specified in ICD-10;
b) poor language and adaptive skills are associated with higher levels of repetitive behaviours;
c) when clustered according to repetitive behaviours, children are more or less grouped according to ability and clinical diagnosis;
d) when all relevant repetitive behaviours are considered, changes over time are evident for all clusters of children, with the general pattern being a decrease, which is contrary to the conclusions of previous literature;
e) ADI-R algorithm scores did show a significant increase in repetitive behaviours for children with ASD, but this was not the case for those with core autism.

Using all available information from parental report on repetitive behaviours in the ADI-R, the components revealed reflected ICD-10 domains. Thus the international classification system appears to mirror reported patterns of abnormal behaviour even in such young children. The fact that ICD-10 categories c and d, (stereotyped/repetitive motor mannerisms, and preoccupations with part-objects or non-functional elements of materials) were combined in this cohort of children is not surprising as these are both 'lower level' types of repetitive behaviour, requiring less cognitive ability than behaviours such as resistance to change (Evans et al., 1997; Turner, 1999). It is planned to follow up this cohort of children in middle childhood, and at that stage repetitive language and circumscribed interests will be included; it is expected that principal components analysis may present a different picture.

Repetitive behaviours were reported for all children with autism and ASD in the present study, even at 2 years of age. Children with autism had significantly more total repetitive behaviours than children with speech and language delays. In addition, children with

core autism reported higher levels of total repetitive behaviour than those with a diagnosis of ASD. Of course, these observations are not totally independent as ADI-R findings were taken into account in making conclusions about clinical diagnosis. The greater the child's ability, the fewer repetitive behaviours, and this was true for all components of repetitive behaviour and total scores. However, as children's expressive language improved at follow-up the relationship with degree of repetitive behaviours became less marked. Thus progress in spoken language does not necessarily lead to a diminution in repetitive behaviour, and fluent speakers can carry on doing unusual stereotyped movements (such as flapping when excited). It would be interesting for future studies to examine further the relationships between repetitive behaviours, language understanding and expressive language, as children develop over time.

Cluster analysis revealed that, on the basis of repetitive behaviour profiles, children with severe autism were distinguished from children with ASD and speech and language delays. However, there were some children with good language skills with autism or ASD in the same cluster as those with language delay or disorder, so the discrimination is not complete. There was also one cluster of relatively able children with greater than expected levels of repetitive behaviour. Their profile supported the suggestion that the type of repetitive behaviour demonstrated is mediated by mental functioning (Berkson & Tupa, 2000; Szatmari et al., 2000). That is, they were reported to show relatively greater Resistance behaviours than the other groupings, perhaps because they could assert themselves verbally. Future follow-up of this group of children will examine whether early repetitive behaviours act as a marker for aspects of cognitive development.

Repetitive behaviours in typically developing children have been found to change over time, moving from simple motor behaviours to complex behaviours before reducing markedly at school age. Changes in repetitive behaviours in autism have also been reported. Previous research (Cox et al., 1999; Lord, 1995; Moore & Goodson, 2003; Stone et al., 1999) has been consistent in concluding that repetitive behaviours increase over the preschool years. In the present study also, the algorithm scores for repetitive behaviours increased in all three groups. However, this was significant only for the children with ASD, who also increased in the social interaction algorithm score. These are likely to be the children whose behaviours seem more unusual to their parents as they grow older, when more sophisticated levels of social interaction with other children, and tolerance of change, are expected by parents and nursery staff. The shorter interval between assessments may explain why the present study does not completely replicate the findings of previous studies with regard to the algorithm scores, and the degree of change may have been more salient in the ASD group. The algorithms include the items of the ADI-R which statistically show the closest relationship with clinical diagnosis and avoid redundancy (Lord et al., 1994) and thus may favour those items which are most stable. Nevertheless, the finding that the repetitive behaviour algorithm items tend to show an increase in severity of reported impact on the child and family has generally been over-interpreted, to mean that all repetitive behaviours increase in frequency and/or impact.

The results from the present research reveal a decrease in total repetitive behaviours when a broader range is included (12 ADI-R items, scored 0–3) and not simply the algorithm items (6 for this age group, scored 0–2). When all the repetitive behaviours relevant to this age-group are asked about, including difficulty with change, the general picture is one of reduction in impact, even for the sensory and motor behaviours which are most noticeable in children with core autism and severe learning disabilities at 2 to 3 years of age. For parents under stress when they receive a diagnosis of autism spectrum disorder for their child, it is perhaps encouraging to know that repetitive behaviours do not inevitably get worse, and that they may perhaps have less of an impact on the family.

However, there are areas of exception to the pattern of decrease. The present study supports suggestions that Interests (unusual preoccupations and attachment to objects) may require higher cognitive abilities and maturation. Some of the cluster of children with relatively greater ability but significant levels of repetitive behaviours showed an increase in Interests, and after the age of four years Circumscribed Interests would also be measured by the ADI-R (not in the present study) which would be likely to add to the reported levels of Interests (South, Ozonoff, & McMahon, 2005).

In summary, as expected repetitive behaviours were shown to differ between clinical populations: those with autism were reported by parents to show more behaviours than children with ASD or speech and language delays. Furthermore behaviour profiles discriminate within a mixed population, revealing associations between language and repetitive behaviours. In this study, for all groups, whether clinically divided or clustered, repetitive behaviours decreased in impact over a 1-year period, with a significant decrease occurring for the group of children with core autism and poor language skills. In contrast with the

conclusions of previous studies, this appears to be hopeful news for parents of children with autism who can be overwhelmed by the invasiveness of excessive repetitive behaviours (Charman, 2000). The study needs to be replicated for the same time interval and age, and also investigated for this cohort over a longer period of time. If the relationship between language development and repetitive behaviours is a true one, it may mean that outcome measures of language programmes, for both children with ASD and for children with specific language disorder, should be broadened to include some qualitative analysis of change or stability in repetitive behaviours.

As most previous studies have reported, there was no repetitive behaviour which could have been used as a specific marker for early identification of ASD, and so assist in the differential diagnosis with language disorder. Nevertheless, the data seem to suggest that intrusive levels of resistance to change, and abnormal idiosyncratic responses (e.g. to particular sounds or smells) would not be expected in children with a specific speech or language disorder. Parental report of such behaviours may require a level of heightened vigilance by professionals involved in language interventions in observing children's behaviour over time, given the findings of previous follow-up studies of children with primary language disorder (Howlin et al., 2000; Michelotti et al., 2002).

The ADI-R was originally designed to survey all aspects of autism and to make a diagnosis on the basis of this information (Lord et al., 1994). While it collects information about repetitive behaviours in a standardised, reliable and detailed way, drawing on rich information provided by parents, it does have the potential limitations of summarising information into categories and rating severity according to impact, rather than frequency. There may be benefit in considering how information could be collected in more specific and detailed ways. A tool designed specifically for the purpose of measuring repetitive behaviours might allow more detailed items to be included (South et al., 2005; Turner, 1999). However, reliance on parental interviews alone raises issues of validity. On one hand, parents of children with autism inevitably develop an understanding of the disorder as they have more contact with their child and with professionals. Thus it is possible that they are more attuned to the types of behaviours in question in later assessments. They may understand the basis for their child's behaviour better, or make different judgements of how intentional their child's behaviours are, once the diagnosis has been made (Gray & Tonge, 2001; Sperry & Symons, 2003). On the other hand, if children's behaviours stay the same over time, i.e. they do not progress as expected, and the contexts become more demanding, their behaviour may seem more abnormal and be reported as changed. Thus, for a variety of reasons, it is possible that information about changes over time is over or under reported. Future studies would be strengthened by combining parent report with direct observations of repetitive behaviours across settings. Furthermore, contact with professionals and other parents of children with autism may enable parents to develop coping strategies for dealing with repetitive behaviours. A perceived and/or actual decrease in behaviours may then be a result of these understandings and interventions (Honey, McConachie, & Le Couteur, 2005). One limitation of the present study is the lack of consistent quantitative or qualitative information about interventions received between the two time points, though all children had been referred to local services, and did receive at least speech and language therapy assessment and intervention. Future studies should aim to address methodological challenges in regard to measurement of repetitive behaviours, and of ongoing services and types of intervention received.

In conclusion, it is evident that research into repetitive behaviour in young children with autism and ASD is important not only as an early potential marker to help with the identification of the disorder and the understanding of precursors to triad features, but also for the design and implementation of therapeutic intervention for families. However, interview and observational tools which measure early repetitive behaviours in sufficient detail will be needed in order to develop fuller understanding. The study shows that the reported impact of repetitive behaviours may decrease during the preschool years, while they nevertheless remain a significant feature within autism and ASD.

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