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Situational *versus* pervasive hyperactivity in a community sample

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SYNOPSIS Groups of home and school situational hyperactive primary schoolboys identified from the community were compared with pervasive hyperactive and non-hyperactive controls on a wide range of measures. The hyperactive groups tended to persist in the same category over a half-year period. Both situational hyperactive groups had lower measured activity levels than the pervasive hyperactive group and only the latter differed from non-hyperactive controls. Home hyperactivity was characterized by poor family relationships and was not distinguishable from non-hyperactive home-antisocial controls. School hyperactive boys had specific correlates of low intelligence, motor clumsiness, poor reading and academic abilities. Pervasive hyperactive subjects differed from both situational groups in showing a higher percentage of delayed language development. While home hyperactivity has dubious identity, the distinct pattern of external correlates in school and pervasive hyperactivity speak for the need to regard these as separate entities.

INTRODUCTION

The low agreement among different informants on children's behaviours is evident in both clinical practice and research data. In a meta-analysis of 119 studies, Achenbach *et al.* (1987) found considerable consistency between reports by pairs of parents, teachers and mental health workers, but the correlations among different types of informants were found to be as low as 0·28. This low correlation among different sources of informants was evident for both internalizing and externalizing problems. Studies in different countries consistently demonstrated that parents and teachers had poor agreement on children's hyperactive behaviours (Rutter *et al.* 1970; Sandberg *et al.* 1980; McGee *et al.* 1984*a*; Ekblad, 1990; Matsuura *et al.* 1993). Sandberg (1986) found that parents' ratings of hyperactivity do not agree with clinic observations or actometer readings. Though the correlations between teachers' ratings and clinic/home observations were generally higher, 6 out of 11 studies reported correlations below 0·5.

The low agreement cannot be explained simply by measurement errors (Achenbach *et al.* 1987). The classification of childhood hyperactivity differs in their views on situational variations of hyperactive symptoms. The DSM-III (American Psychiatric Association, 1980) suggested that primary consideration should be given to teachers' reports while the DSM-III-R (American Psychiatric Association, 1987) explicitly accepted the possibility of situational variations of hyperactive–inattentive behaviours. However, the British researchers (Rutter, 1982; Taylor *et al.* 1986, 1991) and the ICD-10 (World Health Organization, 1992) suggested that pervasive hyperactivity should be a principal criterion. The DSM-IV (American Psychiatric Association, 1993) stipulated that attention deficit or hyperactivity/impulsivity symptoms have to be present in two or more situations. Thus, the nature of situational hyperactivity has direct diagnostic implication.

Compared with situational hyperactivity, pervasive hyperactive children were reported to have earlier onset of problems, more neuro-

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logical abnormalities (Sandberg *et al.* 1978), more behavioural problems, worse prognosis (Schachar *et al.* 1981), more observed motoric activities (Schleifer *et al.* 1975), attention problems (Schleifer *et al.* 1975; Leung & Luk, 1988; Chee *et al.* 1989; Luk *et al.* 1991), lower IQ (Schachar *et al.* 1981; Boudreault *et al.* 1988) and poor reading ability (Boudreault *et al.* 1988). The apparent validity of pervasive hyperactivity quoted above was contradicted by studies employing similar research strategy. Cohen & Minde (1983) reported that pervasive hyperactive subjects did not differ from situational ones in IQ, biological and sociodemographic profile. Rapoport *et al.* (1986) found situational hyperactive children were comparable to pervasive hyperactive children in actometer readings, neurological scores, continuous performance test scores, IQ and academic performance. Pervasive and situational hyperactive groups were more similar to each other than non-hyperactive controls in mother–child interactions and maternal perception of children's problems (Beck *et al.* 1990).

Several methodological problems were evident to various extents in the above quoted studies. First, the dependent measures were restricted to a few aspects of psychopathology. Secondly, subjects were recruited from advertisements or clinics (Sandberg *et al.* 1978; Cohen & Minde, 1983; Rapoport *et al.* 1986; Leung & Luk, 1988; Chee *et al.* 1989; Beck *et al.* 1990; Luk *et al.* 1991) and the results obtained had limited generalizability. Moreover, those who attended clinics may have more severe symptoms. The comparison of situational and pervasive hyperactivity in clinic samples could possibly confound severity with situationality. Thirdly, Biederman *et al.* (1990) pointed out that for those referred hyperactive children diagnosed upon parents' information, there was a 90% chance that this would be agreed by the teachers' information. This finding suggested that pure home-hyperactive cases rarely appeared in clinics and many of the apparent situational hyperactive cases were, in fact, pervasively hyperactive. Indeed, actometer readings failed to discriminate situational from pervasive hyperactive subjects in a tertiary care clinic (Rapoport *et al.* 1986). Fourthly, most studies regarded situational hyperactive children as a homogenous group and this may not be true. Costello *et al.* (1991) demonstrated that home-hyperactive and school-hyperactive children had differential scores of behavioural disturbances in relation to the sources of information.

The importance of splitting situational hyperactive children into home and school subgroups was reflected in two recent community studies. In a sample of 570 13-year-old twins, Goodman & Stevenson (1989*a*) found the correlates of hyperactivity decreased in strength in the order of pervasive, school, home and finally non-hyperactive groups. There was a trend towards school hyperactive children having worse scores in attention tests than home hyperactive ones. Szatmari *et al.* (1990) found externalizing problems reported by parents and teachers were correlated with family functioning and neurocognitive impairment respectively. Both studies suggested that home and school hyperactive subjects might have different patterns of associations.

Given the inconsistency of previous research findings and their methodological inadequacy, there is a need to re-examine the issues. The subjects have to be selected from the community, the nature of pervasive and situational hyperactivity has to be defined operationally and wide ranges of standardized measures have to be employed in order to cover diverse aspects of psychopathology.

There could be several possible views of situational and pervasive hyperactivity, as follows.

1 Pervasive, but not situational hyperactivity, is a valid category. The pervasive group will differ from other groups in terms of external correlates while situational hyperactivity cannot be differentiated from the non-hyperactive controls.

2 Either, or both, situational hyperactive group is similar to the pervasive group and they share the same pattern of external correlates in equal strength.

3 Both home and school hyperactivity are mild variants of pervasive hyperactivity. The situational hyperactive groups will share the same pattern, but in attenuated strength, of external correlates with pervasive hyperactive group.

4 Pervasive hyperactivity is a co-morbid condition of both home and school hyperactivity. Thus, pervasive hyperactive subjects will have

all the external correlates found in two situational hyperactive groups.

5 Either, or both, situational hyperactive groups are valid categories and they differ from the pervasive hyperactive children. Each of them has external correlates that are not shared by any other groups. Judging from the current literature, it may be that pervasive hyperactivity is characterized by neurodevelopmental problems, school hyperactivity by significant deficits in neuropsychiatric measures, and home hyperactivity by disturbances in the family relationship.

This paper attempts to test the listed hypotheses in a representative community sample of primary 1 (i.e. grade 1) Chinese schoolboys in Hong Kong. In order to test the distinct identity of the hyperactive groups, it has to be shown that these external correlates are specific to hyperactivity but not to other externalizing disturbances. To satisfy the latter criterion, a comparison with the non-hyperactive antisocial group is required.

METHOD

Subjects

The Education Department randomly selected 130 mainstream primary schools in Hong Kong and 112 of them agreed to participate. Seven Chinese primary 1 schoolboys were randomly selected from a class of 40. The number of subjects selected was proportionally reduced if the class had less than 40 students. Altogether 3091 boys were sampled and 3069 completed the screening questionnaires (stage 1). This represented a compliance rate of 86 % at school level and 99 % among the subjects selected. Rutter's parent (A2) and teacher questionnaires (B2) were used as the screening instruments. The questionnaires enquired about a wide range of childhood behaviours and were rated on a 3-point scale (Rutter *et al.* 1970, 1974). Based on the scores of the hyperactive subscales (Schachar *et al.* 1981) in the stage 1 questionnaires, subjects were initially classified into four groups. They were pervasive hyperactivity (a score of 3 or above in both parent and teacher hyperactivity subscales), home hyperactivity (a score of 3 or above in parent hyperactivity subscale and below 3 in teacher hyperactivity subscale), school hyperactivity (a score of 3 or above in teacher hyperactivity subscale and below 3 in parent hyperactivity subscale), and non-hyperactivity (a score below 3 in both hyperactivity subscales) (Fig. 1). Then, subjects in the hyperactive groups were stratified into two subgroups: extreme scores in either hyperactive subscales and the rest. A random sample in each subgroup was recruited for intensive study 6 months later (stage 2) and those extreme scores subgroups were sampled in higher proportions. This was to ensure that an adequate number of situational hyperactive cases could be studied. Among the non-hyperactive subjects, those who fulfilled the criteria of conduct disorder (for initial sampling purposes, Rutter's questionnaire criteria of conduct disorder was adopted) were recruited into stage 2. This was to ensure an adequate number of non-hyperactive antisocial subjects was recruited as controls. A total of 649 boys were sampled and 611 (94 %) of them cooperated in stage 2.

Rutter's questionnaires were repeated in stage 2. In view of the likelihood that situational hyperactivity might be a transient complaint (see Results section), only those children who were persistently hyperactive over a period of 6 months between stages 1 and 2 were selected for group comparisons. The definitions for each comparing group are listed below.

1 Pervasive hyperactive group: both A2 and B2 hyperactive subscales scored 4 or above in both stages 1 and 2.

2 Home hyperactive group: A2 hyperactive subscale scored 4 or above and B2 hyperactive subscale scored 2 or below in both stages 1 and 2.

3 School hyperactive group: A2 hyperactive subscale scored 2 or below and B2 hyperactive subscale scored 4 or above in both stages 1 and 2.

4 Non-hyperactive group: both A2 and B2 hyperactive subscales scored 2 or below in both stages 1 and 2.

The cut-offs of 4 and 2 in the A2 hyperactive subscale represented the 81·2 th and 49·6 th percentiles in the screening stage sample respectively. Similarly, the values represented 85·6 th and 61·8 th percentiles in the B2 hyperactive subscale respectively. Non-hyperactive, antisocial groups were selected according to their scores in stage 2 questionnaires. Non-hyperactivity meant that both A2 and B2

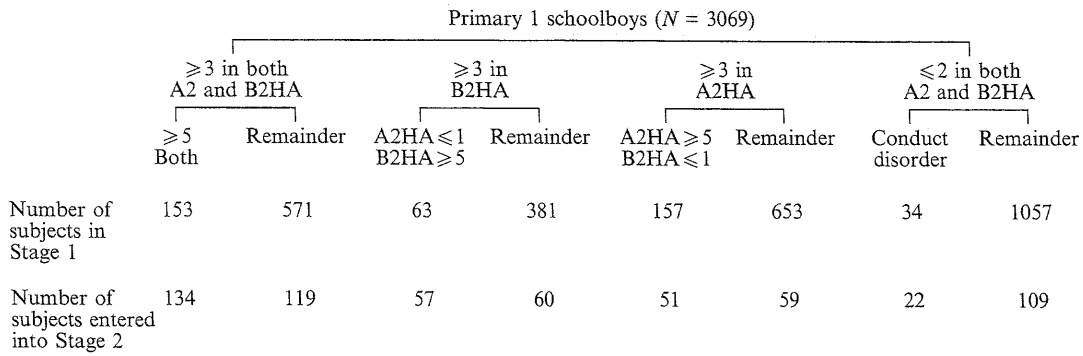

FIG. 1. Sampling of subjects from Stage 1 to Stage 2. Note: A2HA, hyperactive subscale in Rutter's parent questionnaire; B2HA, hyperactive subscale in Rutter's teacher questionnaire; Conduct disorder, total score of A2 ⩾ 13 and antisocial subscale score > neurotic subscale score or total score of B2 ⩾ 9 and antisocial subscale score > neurotic subscale score; Remainder, rest of the subjects within each group.

hyperactive subscales scored less or equal to 3 (71·6 th percentile in A2 and 80·5 th percentile in B2 in screening stage); home antisocial meant A2 antisocial subscale scored greater than or equal to 2 (86·9 th percentile) and B2 antisocial subscale scored less than or equal to 1 (79·1 th in percentile); school antisocial meant B2 antisocial subscale scored greater than or equal to 2 (86·7 th percentile) and A2 antisocial subscale scored less than or equal to 1 (73·2 th percentile). In the selection of non-hyperactive antisocial subjects, the cut-off for absence of hyperactivity was 3 instead of 2. This is because the number of cases was too small to allow group comparisons when a lower cut-off was adopted.

Dependent measures

Information with regard to the child's developmental history, sociodemographic data, family relationship, intelligence, reading ability, academic performance, motor activity level, attention performance, neurological status and motor clumsiness were gathered. Data in the first two areas were obtained from standardized semi-structured interviews with parents (Taylor *et al.* 1986). Family relationships were assessed by standardized interview based on those described by Quinton *et al.* (1984) and adopted by Taylor *et al.* (1986, 1991). The child's academic performance was rated by the class teacher in a semi-structured interview. The research assistants were trained by an experienced worker in London and were blind to the questionnaire scores of the child. The assessment and interviews were performed in a quiet room at school. Based on the data collected, the following dependent variables were constructed. They represented equivalent or conceptually similar measures employed in similar community studies of hyperactivity (Szatmari *et al.* 1989; Taylor *et al.* 1991).

1 A biological risk index was calculated by scoring one point for the presence of each of the following: complications in pregnancy (toxaemia, antepartum haemorrhage, infection, physical illness), delivery (breech, forceps, caesarean section), neonatal period (special care, seizures, difficulty in breathing) and prematurity.

2 Motor delay meant the child could only sit and/or walk after age of 9 and 21 months respectively.

3 Language delay meant any of the following: first word after 21 months, first sentence after 27 months, unclear and grammatically inappropriate speech at age of 5.

4 A social adversity index was calculated by scoring one point for each of the following: broken family, parental unemployment, more than three siblings, living area under 45 sq ft per person and family income less than Hong Kong $5000 (£420 Sterling) per month.

5 A family relationship index was calculated by scoring one point for each of the following: low parental contact with the child, lack of maternal warmth, severe maternal criticism, poor maternal coping with child's problems and parental inconsistency in child-handling. Low parental contact meant the frequency of conversation, reading stories and games with the child was less than once a week. Scores at the

most extreme level of warmth (no, or little demonstration of warmth) and criticism (a lot of criticism throughout much of the interview) were taken to indicate deviance. Maternal coping was rated on an 8-point scale and inappropriate handling associated with adverse consequence (score 5 or more) was regarded as poor coping. Parental inconsistency was scored when there was open argument about discipline and countermanding in front of the child.

6 Teacher-rated academic level was calculated by scoring one point for below average performance in each of the following academic abilities: reading, writing scripts, stories, number concepts, number computation and language usage.

7 A short form of the Hong Kong Wechsler Intelligence Scale for Children (HK-WISC) was performed – the test had been restandardized for local use (Lee *et al.* 1983). The test derived verbal performance and full scale scores of measured intelligence.

8 The 12 min continuous performance test (CPT; Erlenmeyer-Kimling & Cornblatt, 1978) was administered with the use of a portable computer. Pictures composed of a number and a simple shape were presented sequentially on the screen. Each picture remained on the screen for 1 s, with an interval of 1 s between pictures. The task was to press the spacebar of the computer keyboard whenever a picture was identical to the preceding one. This condition occurred on 32 occasions, randomly spread among a total of 268 presentations. Five scores were derived from the test. They were: the number of correct hits; false positives; latency to a correct hit; observer's criteria; and, observer's sensitivity. The latter two scores were calculated on the basis of signal detection theory (Pastore & Scheirer, 1974) and were supposed to measure impulsivity and vigilance, respectively.

9 Direct observation of off-task behaviours was made during the CPT testing session according to a scheme devised by Sandberg *et al.* (1978). Gross body movement (GBM) referred to getting up from a seat or body swinging from side to side. Gaze aversion (GA) was defined as, the eyes looking away from the computer screen.

10 Mechanical actometers tied to the subjects' non-dominant leg during their intelligence assessment and CPT sessions provided objective measures of motor activities. The recordings, expressed in minutes per elapsed time, were log-transformed to correct for skew distribution.

11 The 20-items matching familiar figures test (MFFT; Cairns & Cammock, 1978) was a revised, lengthened and more reliable version of Kagan's original 12-item MFFT. A picture had to be matched to six other replicas, only one of which was identical to it. The total number of errors made and the average latency between the presentation of the pictures and the first response in matching, regardless of whether it was right or wrong, provided measures on the dimension of impulsivity/reflectivity.

12 The digit span test was a test of immediate memory and attention in which the subjects were required to repeat digits read to them, both forwards and backwards. The score was expressed as the number of correct digits recalled.

13 Chinese Word Recognition Test was a test of mechanical reading of pairs of Chinese characters (unpublished test, Education Department of Hong Kong). The raw score was the number of pairs of Chinese characters correctly read. In order to account for the effect of age and IQ on reading ability, an adjusted reading score was calculated in the following manner: the raw scores were weighted according to the sampling ratio from stage 1 to 2, then regressed upon the age and IQ of the subjects. The regression coefficients were used to compute the age and IQ predicted reading scores and the raw score minus the predicted score gave the adjust score.

14 The neurological status of the child was measured by a scored developmental neurological examination (Yule & Taylor, 1987). A high score reflected more neurological soft signs.

15 Tests of motor clumsiness (Gubbay, 1975) included: (*a*) post-box, putting objects of different shapes through holes of matching shapes into a post-box and the score was expressed as the number of seconds required to finish the task; (*b*) catch ball, throwing and catching balls while clapping hands in between; a low score reflected poor perceptual-motor performance.

Analysis

For continuous dependent variables, one-way analysis of variance was used for inter-group comparisons. Because of multiple testings, the most conservative *post-hoc* Scheffé test was

employed. For categorical dependent variables, the chi-squared test was used. For those dependent variables that showed a significant difference among the groups, they were selected and compared with the hyperactive and non-hyperactive antisocial controls. For continuous variables *t* tests were carried out and for categorical variables chi-squared tests were carried out.

RESULTS

Demography and symptom profiles

Table 1 showed the changes of group membership from stage 1 to stage 2 over a period of 6 months. While pervasive and non-hyperactive groups remained largely consistent over time, less than half of the situational hyperactive groups remained in the same category. Few pervasive hyperactive cases became non-hyperactive and vice-versa. A significant proportion of situational hyperactive children became non-hyperactive 6 months later. These transient situational hyperactive cases were likely to introduce 'noise' in group comparisons and the analysis was conducted with subjects persisting in the same group over time. It was noteworthy that home-hyperactive cases rarely became school-hyperactive, and vice versa. Moreover, these persistently hyperactive subjects came from a total of 64 schools and each school identified no more than three hyperactive subjects. Both findings spoke against the possibility of school effects in the identification of hyperactivity.

The group comparisons of basic demographic data were listed in Table 2. The age of the child, immigration status, education levels of the parents and social class of the family as measured by the father's occupation were essentially similar across the four groups. It may be added that nearly all immigrants in the sample were from mainland China and most of them spoke the same dialect as those who were born in Hong Kong.

The symptom profiles of each group were compared using the combined stage 1 and stage 2 questionnaire scores (Table 3). As expected, the hyperactive groups had different scores in parent- and teacher-rated hyperactivity subscales as the group membership predicted. Boys in the home-hyperactive group scored high on the antisocial subscale rated by parents, but not by teachers. The reverse was found in the school-hyperactive group. Overall, the home-hyperactive group had fairly similar questionnaire scores with the non-hyperactive group when they were rated by the teachers. The reverse was true in the school hyperactive group. The pervasive group had the highest readings in all measures of motor-activity levels. There was an increasing trend in measured activity level from non-hyperactive, to both situational hyperactive, and then to the pervasive hyperactive group. In two out of four measures the school-hyperactive group had a trend of higher readings than the home-hyperactive group.

External correlates

The pervasive and home-hyperactive groups had worse family relationships (Table 4). There was a broad trend that showed both pervasive and home-hyperactive groups scored high in every constituent item in the index. The proportions of low maternal–child contact in pervasive, home-, school- and non-hyperactive groups were 22·6, 17·6, 6·7 and 11 % respectively. In the same order: the proportions for lack of maternal warmth were 18·8, 13·3, 0 and 3·2 %; severe maternal criticism were 25, 26·7, 0 and

Table 1. *Persistence of group membership from stage* 1 *to stage* 2

Stage 1:	1. Pervasive-hyperactive	2. Home-hyperactive	3. School-hyperactive	4. Non-hyperactive	Total
Stage 2					
Pervasive-hyperactive	59 (63·4 %)	9 (19·6 %)	12 (26·7 %)	1 (1·1 %)	81
Home-hyperactive	19 (20·4 %)	19 (41·3 %)	5 (11·1 %)	11 (11·8 %)	54
School-hyperactive	11 (11·8 %)	1 (2·2 %)	17 (37·8 %)	8 (8·6 %)	37
Non-hyperactive	4 (4·3 %)	17 (37·8 %)	11 (24·4 %)	73 (78·5 %)	105
Total	93	46	45	93	277

Table 2. *Comparison of demographic data between pervasive and situational hyperactivity*

	1. Pervasive-hyperactive ($N = 59$) Mean/% (S.D.)	2. Home-hyperactive ($N = 19$) Mean/% (S.D.)	3. School-hyperactive ($N = 17$) Mean/% (S.D.)	4. Non-hyperactive ($N = 73$) Mean/% (S.D.)	F-ratio/χ^2 (*post-hoc* Scheffé)
Child's age (months)	90·9 (6·67)	88·2 (3·69)	89·7 (4·87)	90·8 (5·04)	1·41
Father in manual job	76·4%	77·8%	75·0%	73·2%	0·25
Mother below primary education	36·2%	21·1%	35·7%	45·2%	4·01
Father below primary education	30·9%	36·8%	35·3%	26·5%	1·07
Parents are immigrants	46·3%	50·0%	70·6%	65·7%	6·32

Group comparisons by ANOVA and χ^2 tests when data were presented in means (S.D.) and percentages respectively.

Table 3. *Comparison of symptom profile and measured activity between pervasive- and situational-hyperactivity*

	1. Pervasive-hyperactive ($N = 59$) Mean/% (S.D.)	2. Home-hyperactive ($N = 19$) Mean/% (S.D.)	3. School-hyperactive ($N = 17$) Mean/% (S.D.)	4. Non-hyperactive ($N = 73$) Mean/% (S.D.)	F-ratio/χ^2 (*post-hoc* Scheffé)
Combined stages 1 and 2 questionnaire scores					
Parents' rating					
Hyperactivity	10·5 (1·12)	10·2 (1·18)	1·88 (1·05)	1·79 (1·31)	714*** (1, 2 > 3, 4)
Antisocial	4·36 (2·88)	3·21 (2·74)	1·12 (1·17)	0·92 (1·21)	31·4*** (1, 2 > 3, 4)
Total	35·5 (10·7)	32·9 (11·3)	11·6 (6·09)	12·1 (6·98)	88·5*** (1, 2 > 3, 4)
Teachers' rating					
Hyperactivity	10·6 (1·08)	1·74 (1·24)	10·4 (1·17)	1·68 (1·34)	721*** (1, 3 > 2, 4)
Antisocial	7·14 (4·33)	0·42 (0·77)	7·41 (3·48)	1·16 (2·24)	53·0*** (1, 3 > 2, 4)
Total	27·6 (9·89)	5·21 (4·45)	27·5 (8·60)	6·96 (6·23)	99·5*** (1, 3 > 2, 4)
Measured activity: actometer reading					
During CPT	0·68 (0·63)	0·58 (0·53)	0·58 (0·35)	0·31 (0·62)	4·12** (1 > 4)
During IQ test	0·84 (0·55)	0·48 (0·79)	0·70 (0·48)	0·41 (0·59)	5·.97*** (1 > 4)
Observation					
GBM ⩾ 1	35·6%	10·5%	17·6%	12·3%	12·3**
GA ⩾ 3	62·7%	21·1%	52·9%	27·4%	21·1***

CPT = continuous performance test; GBM = gross body movement.
GA = gaze aversion; Total = Total scores in the questionnaire.
*** $P < 0{\cdot}001$; ** $P < 0{\cdot}01$.
Group comparisons by ANOVA and χ^2 tests when data were presented in means (S.D.) and percentages respectively.

0%; poor maternal coping were 10·2, 14·3, 9·1 and 0%; parental inconsistency were 38·3, 35·7, 18·2 and 19·2%. Thus, the parent–child disharmony found in pervasive- and home-hyperactive groups was similar in nature and was not contributed by any specific aspect of their relationship.

More pervasive hyperactive boys had a history of developmental motor and language delay. In the latter measure, both situational-hyperactive groups were not different from non-hyperactive controls. Low intelligence (significantly in performance and full scale scores), poor reading ability (significantly in raw scores and a trend in

Table 4. *Comparisons of external correlates of pervasive- and situational-hyperactivity*

	1. Pervasive-hyperactive ($N = 59$) Mean/% (S.D.)	2. Home-hyperactive ($N = 19$) Mean/% (S.D.)	3. School-hyperactive ($N = 17$) Mean/% (S.D.)	4. Non-hyperactive ($N = 73$) Mean/% (S.D.)	F-ratio/χ^2 (*post-hoc* Scheffé)
Social adversity index	1·58 (0·95)	1·56 (0·83)	2·00 (1·33)	1·52 (0·94)	2·10
Family relationship index	1·36 (1·30)	1·53 (1·66)	0·46 (0·68)	0·64 (0·94)	4·44** (1 > 4)
Biological risk	0·74 (1·08)	0·60 (0·91)	0·50 (0·73)	0·49 (0·79)	0·70
IQ					
Verbal	106 (19·1)	104 (17·3)	95·0 (23·1)	107 (19·0)	2·01
Performance	105 (17·9)	111 (14·2)	92·2 (19·6)	109 (14·9)	5·55** (1, 2, 4 > 3)
Full	105 (15·6)	107 (11·7)	93·0 (18·6)	108 (14·7)	4·47** (1, 4 > 3)
Reading					
Raw score	34·9 (10·6)	32·6 (13·9)	22·7 (8·73)	35·0 (10·6)	5·60** (1, 4 > 3)
Adjust score	−0·39 (11·2)	−2·15 (14·9)	−7·72 (10·5)	0·28 (9·00)	2·28
Teacher rated academic level	0·33 (0·34)	0·21 (0·34)	0·50 (0·34)	0·23 (0·31)	3·11* (3 > 4)
Neurodevelopmental					
Motor delay	15·7%	10·5%	0%	1.5%	10·1*
Language delay	40·9%	11·1%	12·5%	12·3%	15·2**
Neurological score	11·2 (6·63)	10·6 (4·50)	10·1 (4·75)	7·30 (3·93)	2·47
CPT					
Hit	26·8 (3·80)	25·6 (6·64)	26·8 (4·92)	27·3 (5·76)	0·50
False positive	6·94 (1·69)	8·77 (1·95)	10·5 (2·98)	3·79 (1·24)	5·34** (1 > 4)
Time positive	0·73 (0·11)	0·71 (0·10)	0·72 (0·14)	0·69 (0·15)	0·99
Observer sensitivity	0·94 (0·07)	0·88 (0·28)	0·92 (0·07)	0·95 (0·06)	2·22
Observer criteria	0·61 (0·57)	0·49 (0·71)	0·04 (1·53)	0·69 (0·83)	2·11
MFFT					
Latency	8·86 (4·36)	7·23 (2·02)	6·91 (3·41)	9·39 (9·10)	0·84
Errors	27·2 (9·33)	29·5 (9·91)	34·0 (11·0)	29·1 (12·3)	1·66
Digit span	9·08 (2·55)	9·40 (4·33)	8·93 (2·31)	9·38 (2·41)	0·13
Clumsiness test					
Catch ball	3·48 (1·16)	3·90 (1·52)	2·93 (1·10)	3·67 (1·01)	1·76
Post-box	15·4 (3·55)	14·5 (2·66)	20·8 (9·28)	16·8 (4·68)	4·98** (3 > 1, 2)

Note: CPT = continuous performance test.
Group comparisons by ANOVA and χ^2 tests when data were presented in means (S.D.) and percentages respectively.
** $P < 0{\cdot}01$; * $P < 0{\cdot}05$.

adjust scores), low teacher-rated academic level and motor clumsiness (significantly in the post-box text and trend in catching the ball test) occurred exclusively in the school hyperactive group. The continuous performance test failed to discriminate the groups except that the school-hyperactive boys had more false positive responses. The possible attention deficits in

Table 5. *Comparison of hyperactive and non-hyperactive antisocial groups*

	Pervasive		Home		School	
	Hyperactive ($N = 59$) Mean/% (S.D.)	Antisocial ($N = 11$) Mean/% (S.D.)	Hyperactive ($N = 19$) Mean/% (S.D.)	Antisocial ($N = 48$) Mean/% (S.D.)	Hyperactive ($N = 17$) Mean/% (S.D.)	Antisocial ($N = 35$) Mean/% (S.D.)
Family relationship	1·36 (1·60)	0·44 (0·73)**	1·53 (1·66)	0·95 (1·18)	0·46 (0·68)	0·55 (0·80)
Motor delay	15·7%	10·0%	10·5%	11·4%	0%	13·3%
Language delay	40·9%	0%*	11·1%	14·3%	12·5%	17·2%
IQ						
Verbal	106 (19·1)	109 (20·5)	104 (17·3)	103 (20·8)	95·0 (23·1)	107 (15·0)*
Performance	105 (17·9)	105 (14·1)	111 (14·2)	106 (17·5)	92·2 (19·6)	105 (13·9)*
Full	105 (15·6)	107 (15·5)	107 (11·7)	105 (15·3)	93·0 (18·6)	107 (12·0)**
Reading						
Raw score	34·9 (10·6)	29·1 (8·9)	32·6 (13·9)	31·4 (10·2)	22·7 (8·73)	29·0 (9·21)*
Adjust score	−0·39 (11·2)	−5·72 (7·69)	−2·15 (14·9)	−1·80 (8·39)	−7·72 (10·5)	−5·60 (9·39)
Teacher rated academic level	0·33 (0·34)	0·25 (0·27)	0·21 (0·34)	0·23 (0·28)	0·50 (0·34)	0·27 (0·25)*
CPT						
False positive	6·94 (1·69)	6·12 (1·45)	8·77 (1·95)	6·94 (2·02)	10·5 (2·98)	6·52 (1·40)
Observer's criteria	0·61 (0·57)	0·54 (0·76)	0·49 (0·71)	0·58 (0·81)	0·04 (1·53)	0·65 (0·51)
Clumsiness test						
Post-box	15·4 (3·55)	15·9 (4·59)	14·5 (2·66)	16·5 (6·67)	20·8 (9·28)	17·8 (5·16)
Catch ball	3·48 (1·16)	3·75 (0·46)	3·90 (1·52)	3·88 (0·98)	2·93 (1·01)	3·92 (1·12)**
Neurological score	11·2 (6·63)	8·25 (3·88)	10·6 (4·50)	8·00 (3·74)	10·1 (4·75)	8·28 (4·41)

Note: Group comparisons by t tests and χ^2 tests when data were presented in means (S.D.) and percentages respectively.
** $P < 0·01$; * $P < 0·05$.

school-hyperactive children was partly supported by observations that they had a low observer criterion in the CPT, short latency and made more errors in the MFFT. Though the results fell short of statistical significance, they suggested a coherent trend that the school-hyperactive children were probably more impulsive and set a lower threshold for responding.

The remainder of the dependent measures including social adversity, digit span, biological risk and the neurological score did not differentiate the groups. It was noteworthy that the pervasive hyperactive boys had the highest scores in the latter two measures among all groups and nearly reached statistical significance for neurological abnormalities ($P = 0·07$).

Specificity of external correlates

As shown in Table 3, antisocial behaviours often coincide with hyperactivity. The former can be a confounding factor in the search of external correlates of hyperactivity. Thus, three non-hyperactive pervasive/situational antisocial groups were selected as controls and compared with their corresponding hyperactive groups. The dependent measures were selected from those that had previously shown significant (or a clear trend) group differences. History of language delay and poor family relationship, but not soft neurological soft signs, were more prominent in pervasive hyperactive children than non-hyperactive pervasive-antisocial controls (Table 5). Home-hyperactive and non-hyperactive home-antisocial groups had similar family relationship scores. Therefore, this dependent measure was not a specific correlate for home hyperactivity. On the contrary, school-hyperactive children continued to have significantly lower IQ, poor reading scores, worse teacher-rated academic performance and motor clumsiness than their non-hyperactive school-antisocial counterparts. Attention performance, measured by the continuous performance test, failed to differentiate the hyperactive group from antisocial controls.

DISCUSSION

At the time of the field work, there was a total of 988 primary schools and 43760 primary 1 schoolboys in Hong Kong (Education Department of Hong Kong, personal communication).

Our screening sample of 112 schools and 3069 boys represented 11% and 7% of the relevant populations, respectively. The large number of schools and children randomly selected from different parts of Hong Kong, as well as the good compliance rates, ensured a representative sample with broad coverage both geographically and socio-economically. Subjects were grouped on the basis of questionnaire ratings. The cut-offs were set arbitrarily with the aim of achieving homogeneity but the number of subjects in each group were large enough. The groups represented boys with behavioural deviance but not diagnostic entities.

The study begins with the premise that low parent–teacher agreement on ratings of hyperactive behaviours cannot be explained away by errors in measurement. This is supported by the finding that situational hyperactivity persists over time. The strength of persistence across time was fairly strong. Though only half of both situational hyperactive groups persisted in the same category 6 months later, very few cases shifted from the home-hyperactive group to the school-hyperactive group and vice versa. This became more remarkable knowing that the boy had been promoted to a new class 6 months later and was rated by different teachers in stages 1 and 2. If the low agreement is due to errors in measurement, one would expect that children with hyperactivity in one situation are at risk of being rated as hyperactive in other situations. However, there is little evidence of this. It may be argued that the school-hyperactive subjects were selected because of erroneous ratings from a small group of teachers, but the large number of schools these subjects came from spoke against the notion of school effects in the identification of hyperactivity. These findings suggest that questionnaire ratings capture some enduring behaviours of the child and emphasize the strength of situational determinants.

There was no difference among groups in terms of the age of the child and basic demographic data. The pervasive-hyperactive group had very similar hyperactive subscale and total scores to the home-hyperactive group, if rated by parents. This was the same for the school-hyperactive group if rated by teachers. Both findings suggest that the differences in associations cannot be attributed to variations in basic demographic profiles or severity of rated symptoms. Moreover, the home-hyperactive group had higher scores in hyperactive subscale than the school-hyperactive group if rated by parents, but comparable scores with non-hyperactive controls if rated by teachers. The reverse was found in the school-hyperactive group. This confounding effect between informant and information was in agreement with the findings of Costello *et al.* (1991). It emphasizes the fact that differential external associations in situational hyperactivity have to be sought from objective measures.

Does the child behave differently in different settings? This question is not completely answered in the present study. In a controlled testing environment, the pervasive hyperactive group had higher measured activity levels than the non-hyperactive controls. This strengthens the validity of pervasive hyperactivity in terms of objectively measured motor activity. Both situational hyperactive groups occupied a mid-rank position. Situational specificity is not complete, for the parent and teacher ratings both predict objective measures of activity level. Our limitation lies in the fact that the measurements were done in a laboratory-like setting. Had *in vivo* recordings of motor activities in home and school settings been made, the measures would have provided a better validation of parent-rated and teacher-rated hyperactivity.

What is the nature of situational and pervasive hyperactivity? When the dependent measures were compared across groups, a pattern of group differences was evident. Home hyperactivity was characterized by poor family relationships; pervasive hyperactivity by delayed language and motor development, and poor family relationships; school hyperactivity by low IQ, poor reading ability, worse teacher-rated academic performance, clumsiness, and possibly attention deficits. Judged from these differential patterns of associations, situational hyperactive groups do not resemble non-hyperactive children, neither are they equivalent to each other. Nor does it appear that situational hyperactivity shares the same type of external correlates with pervasive hyperactivity in attenuated strength. Thus, the concept of pervasive hyperactivity being a more severe or narrow entity relative to situational hyperactivity is not supported by our data. The pervasive-hyperactive group does not have the external

correlates of both situational hyperactive groups and cannot be said to be a co-morbid condition.

It is interesting to note that poor family relationship only correlates with parent-rated hyperactivity (i.e. the difficulty is found in both pervasive- and home-hyperactive groups). This result ran contrary to that reported by Beck *et al.* (1990) who found pervasive and situational hyperactive groups had a similar level of maternal distress and perceptions of the child's behavioural problems. Unfortunately, Beck did not divide situational hyperactivity into home and school subgroups and our data clearly showed that they had very different scores in the family relationship index. Though our results fall short of indicating the direction of causality between home hyperactivity and parent–child relationship, they suggest that the stressful relationships and disharmony warrant close monitoring and possibly intervention. In terms of the nosological status, the home-hyperactive group has similar poor family relationship to the non-hyperactive home-antisocial controls and they did not differ from the non-hyperactive boys in the rest of the measures. This raised doubts if home hyperactivity can be distinctly differentiated from non-hyperactive home antisocial controls. It can of course be simply that parents are less good raters of hyperactivity though this view will not be wholly compatible with the findings that parent's ratings predicted persistence over time and objectively measured motor activity.

On the other hand, a history of language delay occurred specifically in the pervasive hyperactive group and this group tended to have the highest neurological scores. The findings are in line with those reported by Sandberg *et al.* (1978) and Taylor *et al.* (1986, 1991). Considering the possible cross-cultural differences in the rating of hyperactivity, this same pattern of external correlates suggests a neurodevelopmental basis for pervasive hyperactivity.

The specific correlates of low intelligence, poor reading, academic backwardness and possibly motor clumsiness in school hyperactivity resembled the study by Szatmari *et al.* (1990) in which neurocognitive impairments were more associated with teachers' reports of externalizing problems. August & Garfinkel (1989) also identified a small subgroup of attention deficit disorder according to teachers' rating in a non-referred sample that was characterized by reading and attention problems. Thus, teacher-rated hyperactivity in Hong Kong is capable of identifying a similar group of hyperactive children reported in the West. However, this finding is at odds with that reported by Schachar *et al.* (1981) and Goodman & Stevenson (1989*a*). Both reported that intellectual and reading problems were characteristics of pervasive rather than school-hyperactivity. It is noteworthy that both McGee *et al.* (1984*b*) and Costello *et al.* (1991), studying non-referred children, reported no group difference between pervasive and situational hyperactivity in IQ, remedial education or reading performance. The different findings do not seem to be related to the stringency with which the groups are defined. The definition of our groups includes a persistence criterion, a more stringent requirement than the above quoted studies. If the failure to find a group difference in the studies of McGee *et al.* (1984*b*) and Costello *et al.* (1991) is due to looser criteria in grouping, it remains difficult to comprehend why the present study finds that intellectual and reading deficits appear in school- rather than pervasive-hyperactivity.

It can be argued that the group of school-hyperactive children have unusually tolerant and acceptive parents and, therefore, the group differences reflect the degree of home support the child enjoys rather than true behavioural differences on the part of the child. However, the school-hyperactive group did not differ remarkably from the non-hyperactive group in terms of family relationship index. Therefore, they cannot be said to have unusually good family relations. Furthermore, it is difficult to comprehend why a good parent–child relationship should correlate with a low intellectual score, poor academic ability and motor clumsiness.

Could the situational and pervasive hyperactivity have different biological and psychosocial roots? It is possible that the pervasive group represents essentially a group with early origins. Their hyperactivity appears early, it disrupts learning that happens during infancy so that language function is disrupted. When the children attend schools, then those with the most severe problem and worst neurodevelopmental delays continue to express their hyperactive behaviours in the new school environment, and are therefore classed as pervasive;

while those who are less affected do not show hyperactivity in school and are defined as a home-specific problem. On this account, school-specific hyperactivity may develop later. Children with cognitive and academic difficulties would have an increased load upon their attention and concentration, and they may well present with hyperactive behaviour even though they have never shown it at home.

As far as it may, the specific correlates of intellectual, reading and academic backwardness in school-hyperactive group naturally hint that their hyperactive behaviours may be reactive to environmental determinants present in the school setting. In other words, these children become hyperactive and inattentive because they cannot cope with the intellectual demands and highly structured environment in school but they will behave in a less hyperactive way in situations (e.g. home) that do not stretch their limited intellectual and attentional capacity. There are some limited evidences in the literature that support this direction of causality (McGee & Share, 1988). Empirical data appear to suggest a two-way effect, as well as one-way or the other (McGee *et al.* 1986; Fergusson & Horwood, 1992; Rowe & Rowe, 1992). Nonetheless, the argument raises the concern that school hyperactivity, possibly reactionary in nature, may constitute a different type of disorder from that of a more innate neurodevelopmental basis for pervasive hyperactivity.

In terms of diagnostic implications, our data suggest more heterogeneity in hyperactivity than that envisaged in the DSM or ICD system. Hyperactivity is not a homogeneous entity and should not be regarded as a single category. Home-specific hyperactivity is dubious in its identity since it was very much more difficult for us to find any distinctions between hyperactivity and antisocial disturbances upon the basis of parent ratings. The different correlates of school and pervasive hyperactivity speak against amalgamating them as if they are the same. The views in the DSM-III or DSM-III-R, which make no differentiation of pervasive from situational hyperactivity, are not supported by our data. However, merely retaining the concept of pervasive hyperactivity as described in the ICD-10 or the DSM-IV will lose the distinctive school-hyperactive group, which in our data, is characterized by intellectual, reading and academic backwardness.

In terms of future research, there can be two lines of study. The first is a genetic strategy. Given the high heritability of hyperactive behaviours (Goodman & Stevenson, 1989*b*), twin studies may indicate whether the co-twins of probands are likely to express hyperactive behaviour regardless of situation, or only in a situation-specific setting. The second strategy is a longitudinal follow-up study. Will the stability over time, which we have described, extend over a longer time period? Will the various hyperactive groups run to different developmental trajectories? Is it possible that the school-hyperactive children identified in the present study become pervasive hyperactive when they reach late childhood? The external correlates of the late childhood pervasive hyperactivity will then bear the characteristics of the present school and pervasive hyperactive groups and become comparable to those reported by Schachar *et al.* (1981) and Goodman & Stevenson (1989*a*); both studies were carried out at late childhood. Our data are essentially cross-sectional in nature and a follow-up study of situational hyperactive children would help to clarify the issues. It would also be useful to identify pre-school hyperactive children and follow them through the period of settling into the school environment.

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