The Measurement and Construct Validity of Disruptive Childhood Behaviours

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There has been a large number of studies of child behaviours and these have led to a proliferation of methods of measuring and classifying behavioural variation. Two dimensions of behaviour that have emerged from many studies are conduct disorder and attention deficit. Children scoring high on conduct disorder are characterised by aggressive, antisocial, oppositional or defiant behaviours, whereas those scoring high on attention deficit are characterised by restless, hyperactive, distractable or inattentive behaviours. However, whilst distinctions have been drawn between conduct disorder and attention deficit behaviours, there are a number of issues relating to the measurement and validity of these variables which require further examination. Three of the major issues which require examination are:

Scales or Categories

Methods for measuring and classifying child behaviour have evolved in two rather different traditions which have used different methods for describing behavioural variation. First, research based on a clinical psychiatric tradition has tended to classify subjects as "disordered" or "non disordered" on the basis of standardised diagnostic criteria. This approach is well illustrated by the Diagnostic and Statistical Manual IIIrd Edition and the later version of this method of classification [1,2]. The alternative tradition, which has come from psychometrics, has tended to describe behavioural variation in terms of scale dimensions in which the severity of symptomatology is assumed to range from none to severe. These traditions have co-existed rather uneasily and this uneasy co-existence has been exacerbated by the fact that the same terminology has been used to describe both categorical and dimensional representations of the same variable. Thus for example the term "conduct disorder" has been used to describe both a diagnostic classification and a scale dimension.

The reasons for the evolution of these different approaches to classifying behavioural variation are fairly obvious. From the stand-point of clinical practice, the use of a diagnostic model is highly attractive. This approach fits in with the medical model of diagnosis, treatment and prognosis which underlies psychiatry and also makes it possible for clinicians to communicate with each other about the symptoms shown by their patients. However, whilst a diagnostic categorical model fits well with the clinical foundations of psychiatry, this model is less appealing for statistical analysis. Typically the use of diagnostic criteria results in highly skewed dichotomous variables which usually have very limited statistical tractability. For this reason

psychometricians and statisticians have tended to prefer the use of dimensional models of behaviour since these permit the application of more powerful and searching methods of analysis.

Whilst it is clear that the development of different methods of measuring conduct disorder and attention deficit have largely evolved from different research traditions and assumptions, it is also clear that neither clinical convenience nor statistical tractability are sufficient grounds on which to base the measurement of childhood behavioural variation and there is a need to examine the validity and scientific utility of different measurement methods.

The scales versus categories debate has been long-standing and this has led to a number of attempts to resolve these issues through the analysis of measures of symptom reports. In a number of studies, different analysts have attempted to examine and test the extent to which observed symptom levels conform to categorical or dimensional models of behavioural variation [3,4,5,6]. However, these analyses have generally been non-informative owing to the difficulties in strongly discriminating between categorical and dimensional representations of the same set of symptoms. The extent of these difficulties is well illustrated in a recent edition of *Sociological Methods and Research* in which four analysts were set the task of analysing a series of items measuring depression and anxiety derived from the Diagnostic Interview Schedule. Four models were considered: a) dichotomous factor analysis [7]; b) latent trait analysis [8]; c) latent class analysis [9] and d) grade of membership analysis [10].

Whilst these measurement models are based on widely differing assumptions, it is notable that for the four cases considered, each of the investigators was able to show the observed symptom data were consistent with their particular brand of analysis. In commenting on these results Schoenberg & Arminger [11] note "Each of these methods solve a set of problems while sometimes creating other problems.... The consequences of the array of differences and similarities of these models is the difficulty in choosing among them for particular applications" (p165). Given this finding it seems fairly clear that it is unlikely that the categories versus scales debate will be resolved adequately through the analysis of symptom level data.

An alternative method for distinguishing between categorical and dimensional models of symptom data has been suggested by Caron and Rutter [12] who note that one way of approaching this problem is to examine the predictive properties of categorical and dimensional variables. They suggest that evidence of a consistent dose/response relationship between levels of symptom severity and some defined outcome variable is generally consistent with the view that a variable has dimensional properties whereas the presence of a discontinuous relationship between symptom severity and the outcome is suggestive of a categorical variable.

The first question addressed in this paper concerns the extent to which measures of conduct disorder and attention deficit behaviours have dimensional properties and the extent to which these variables act as discrete "case"/"non case" variables. To

examine this issue we consider the relationships between conduct disorder and attention deficit symptoms during middle childhood and juvenile offending and scholastic performance during early adolescence to determine the extent to which there are continuous or discontinuous relationships between the level of symptom severity during middle childhood and outcomes in early adolescence.

Are Conduct Disorder And Attention Deficit Different Measures Of Child Behavioural Variation Or Are They The Same Thing Measured In A Different Way?

Whilst many authors have distinguished between conduct disorder and attention deficit behaviours, there has been some debate about the extent to which these behaviours constitute separate domains of child behaviours [see 13,14,15,16]. In general, many studies have found that conduct disorder and attention deficit symptoms are highly correlated and comorbid and this, inevitably, raises the issue of the extent to which conduct disorder and attention deficit are different aspects of child behaviour and the extent to which they may be merely the same behaviour measured in somewhat different ways. This issue has been ably reviewed by Hinshaw [17] who notes that there have been two general approaches to determining the dimensionality of conduct disorder and attention deficit measures: factor analytic studies and studies of symptom overlap.

Factor Analytic Studies :

There have been a large number of studies which have attempted to establish the distinction between conduct disorder and attention deficit using methods of common factor analysis [e.g. 18,19,20,21] . In these studies the extent to which the matrix of correlations between conduct disorder and attention deficit items can be represented by one and two factor solutions has been examined. In general, the majority of studies using this approach have found evidence for a two factor solution with common factors of conduct disorder and attention deficit which are correlated. However, not all studies have produced these results and in a review of 60 studies, Hinshaw [17] reports that nearly a third produced results which favoured a single factor solution.

Studies of Syndrome Overlap

An alternative approach has been to examine the extent to which children classified as having conduct disorder present with symptoms of attention deficit and the extent to which those with attention deficit present with symptoms of conduct disorder [e.g. 22,23,24,25]. These studies have typically produced evidence of substantial overlap between conduct disorder and attention deficit, although there is some evidence to suggest that the two groups can be discriminated on the basis of a number of factors including independent behavioural factors, peer status, social cognitive information processing and prognosis [17,26].

Whilst the weight of the evidence favours the view that conduct disorder and attention deficit are distinct dimensions of child behaviour, it may be argued that tests of this hypothesis have tended to be relatively weak. Factor analytic studies are limited by the fact that the common factor model is a rather imprecise method of theory testing to the extent that this model fails to take into account theoretical considerations and is based on the application of a mechanistic analytic model [27].

Studies examining symptom overlap have been limited by the fact that these studies have often been conducted on clinical samples raising issues about the generality of these findings [17]. In addition, measures of symptom overlap do not provide direct tests of the dimensionality of item sets rather they merely measure the extent to which dimensions are or may be correlated.

The second aim of this study is to employ methods of confirmatory factor analysis to examine the extent to which measures of attention deficit and conduct disorder during middle childhood fit single factor models or the extent to which there are two separate factors with one of these factors corresponding to conduct disorder and the other to attention deficit.

The Predictive Validity Of Conduct Disorder And Attention Deficit Behaviours

Although it has been conventional to distinguish between conduct disorder and attention deficit behaviours in children, for the most part these distinctions have been based on the analysis of symptom data. However, if the distinction between conduct disorder and attention deficit is to be scientifically useful it must not only be shown that these behaviours form distinct dimensions of child behaviour but also that early conduct disorders and attention deficits have different developmental consequences.

There has been a large number of studies that have examined the relationships between early behaviour and later development. [For reviews see 28,29,30,31,32]. Early studies in this area tended to suggest diffuse relationships between early behaviour and later outcomes so that children who showed either conduct disorder or attention deficit behaviours during middle childhood were at greater risk of later adverse outcomes including juvenile offending and poor academic achievement. However, these studies were limited by the fact that analysts failed to distinguish between conduct disorder and attention deficit behaviours; both types of behaviours were not measured or that the correlations and comorbidities between conduct disorder and attention deficit behaviours were not taken into account.

Two recent studies which do not contain these deficiencies tend to suggest that there are highly specific relationships between early childhood behaviours and later outcomes. In general, this research tends to suggest that conduct disorder in the absence of attention deficit behaviours is associated with increased risks of antisocial behaviours including juvenile offending and substance use but is not associated with later academic problems whereas attention deficit behaviour in the absence of conduct disorder is associated with increased risks of academic problems but not with

increased risks of antisocial behaviours [33,34]. If such findings can be replicated they provide important construct validation of the distinction between conduct disorder and attention deficit behaviours since they would indicate that not only can these behaviours be distinguished on the basis of symptom level data but also that developmental consequences of early conduct disorders and early attention deficit behaviours are different.

The third aim of this paper is to report on a longitudinal study of the relationship between conduct disorder and attention deficit measures during middle childhood and offending and school performance at the age of 13 years to examine the extent to which there are specific relationships between early problem behaviours and the types of outcome observed in early adolescence.

METHOD

The data reported here were collected during the course of the Christchurch Health and Development Study. In this study a birth cohort of 1265 children born in the Christchurch urban region has been studied at birth, four months, one year and annual intervals to the age of 15 years using data collected from parental interviews, child interviews and teacher reports (for an overview of the research design and summary of previous findings see [35]). The following measures were used in this analysis.

Child Behaviour In Middle Childhood

When the children were eight and nine years old measures of conduct disorder and attention deficit were obtained from:

a) Maternal report using a questionnaire based on a combined version of the Rutter [36] and Conners [18,37] maternal report questionnaires: and ii) teacher reports of child behaviour obtained using a parallel version of the maternal measure which was based on a combined version of the Rutter [36] and Conners [18,37] teacher report questionnaires.

b) Additionally, when the children were nine years old, child self-reports of conduct disorder were obtained using the Children's Self-Report Psychiatric Rating Scale [38]. The items in these questionnaires were scaled to provide two different measures of child behaviour.

Firstly, the items were combined to construct unidimensional scale measures reflecting the extent to which each source reported that the child expressed tendencies to conduct disorder/oppositional behaviour and attention deficit behaviour. The construction of these scale measures has been described in a previous paper [39] and the resulting scales were of moderate to good reliability with reliability (alpha) coefficients ranging from .75 to .95.

To produce categorical models of the data the items were used to classify children according to DSM III-R criteria for oppositional defiant disorder (ODD) or attention deficit/hyperactivity disorder (ADHD) using methods comparable to Anderson,

Williams, McGee & Silva [40]. In this classification children meeting criteria for ODD or ADHD were classified as cases and children failing to meet criteria were classified as non-cases.

Scholastic Ability at Age 13 Years

This was based on the Test of Scholastic Abilities (TOSCA; [41]) administered when the children were 13 years old. This test measures the extent to which the child exhibits the skills and competencies necessary for academic work at school. The test measures the child's abilities in three content domains (numbers, letters, sentences) and three process domains (conceptualisation, classification and operations). The test has been shown to fit a single factor model [42] and is of high reliability.

Measures of Early Offending

Early offending was measured by administering the Self-Report Early Delinquency Scale (SRED; [43]) at ages 12 and 13 to both the child's mother and the child. Administration was conducted independently with the mother being interviewed at home and the child while at school. The measures used in this analysis were:

a) The total number of offences which the child reported committing by the age of 13 years.

b) The total number of offences which the child's mother reported that the child had committed by the age of 13 years.

RESULTS

Dimensional and Categorical Models of Conduct Disorder and Attention Deficit

The first question addressed by this analysis concerns the extent to which it is scientifically useful to describe variations in conduct disorder and attention deficit behaviours using categorical or dimensional models. This issue is examined in Table 1 which shows the relationships between offending behaviours and scholastic achievement at age 13 years related to measures of conduct disorder and attention deficit at age eight. Two approaches to measuring conduct disorder and attention deficit behaviours are presented. The first approach measures these constructs using dimensional models in which the severity of symptoms at age eight is assumed to range from none to severe. The measure used is based on combined maternal and teacher reports which rank children from those with the lowest levels of symptomatology to those with the highest levels. For purposes of data display these continuous variables have been classified into six class intervals which rank the sample from children who were asymptomatic (Group 1) to children with conduct disorder or attention deficit scores that placed them in the most disordered 10% of the sample. The alternative method uses a categorical model based on DSM III-R criteria for ODD and ADHD.

Table 1: Relationship between dimensional and categorical measures of conduct disorder, attention deficit at age 8 and offending and scholastic performance at age 13.

	N	% Offenders (at 13 yrs)	TOSCA Score (at 13 yrs)
CONDUCT PROBLEMS (at 8 years)			
Dimensional Model			
1 (Low)	142	19.7	40.56
2	208	20.7	37.35
3	133	21.1	34.60
4	152	32.2	32.95
5	67	70.2	26.46
6 (High)	59	69.5	26.18
		p<.0001	p<.0001
Categorical Model			
Not ODD	740	30.3	35.01
ODD	21	57.1	25.54
		p<.01	p<.005
ATTENTION DEFICIT (at 8 years)			
Dimensional Model			
1 (Low)	169	18.9	41.24
2	164	15.2	39.80
3	163	28.8	34.79
4	135	41.5	30.39
5	67	49.3	28.42
6 (High)	63	68.3	20.19
		p<.0001	p<.0001
Categorical Model			
Not ADHD	722	28.5	35.42
ADHD	39	76.9	21.90
		p<.0001	p<.0001

The table shows evidence of clear dose-response relationships between the level of conduct disorder and attention deficit symptoms at age eight years and rates of offending and levels of scholastic performance at age 13 years. Children with scores in the most disordered group of the symptom distribution had rates of offending which were 3.5 to 3.6 times higher than children who were asymptomatic and similarly children with scores in the most disordered 10% of the distribution had mean scholastic performance scores which were between .95 to 1.39 standard deviations lower than children in the lowest 20% of the conduct disorder or attention deficit distributions. In all cases there were highly significant relationships between the extent of early conduct disorder or attention deficit and risks of offending or levels of scholastic performance at age 13 years. In general, as symptoms of behavioural problems at age eight years tended to increase there were corresponding increases in the risk of offending and corresponding decrements in the levels of scholastic achievement. The Table also shows that children classified as having ODD or ADHD had significantly higher rates of offending and significantly lower levels of academic achievement.

However, whilst both the categorical and dimensional models of the symptom data were prognostic of outcomes at age 13 years, it is clear from inspection of the Table that the dimensional model led to generally better levels of prediction. This can be seen directly from the results in Table 2 which compares the predictive power of the dimensional and the categorical models of attention deficit and conduct disorder. In this Table the predictive power for the measure of offending is based on a relative risk measure which compares the rate of offending in high and low groups whereas the measure of prediction for the scholastic ability score is based on the amount of explained variance. Table 2 shows that, in both cases, the explanatory power of the dimensional model is greater than the explanatory power of a model based on DSM III-R criteria. The relative risks of offending for the dimensional model range from 3.58 to 3.61 compared with the relative risks of 1.88 and 2.64 for the categorical model. In terms of explained variance in the measures of scholastic performance the dimensional model explains between 9% to 17% of the variance compared with 1% to 4% variance explained for the model based on DSM III-R criteria.

The reasons for the poorer explanatory power of the model based on DSM III-R criteria are readily evident from inspection of Table 1. This Table shows that there are generally continuous dose/response relationships between levels of symptom severity and risks of offending or scholastic performance at age 13 years. However the DSM III-R model assumes that this continuous distribution can be described by a classification in which a minority of subjects are cases and the remaining subjects non-cases. Implicit in this approach is the assumption that subjects who fail to meet diagnostic criteria form a single homogeneous group who have a common prognosis. However, this is manifestly not the case since the distributions of symptom levels show that those failing to meet diagnostic criteria vary both in their levels of symptom severity

and that these variations are related to the child's future offending behaviour and level of academic performance. The result of this is that by dichotomising what appears to be a continuous variable describing the range of symptomatology in the child population, the DSM III-R approach loses information about this distribution and this loss of information is reflected in the lower predictive power of measurements based on DSM III-R criteria.

Table 2: Comparison of the predictive power of categorical and dimensional models (8 years).

	Offending (RR)	Scholastic Performance (% Variance)
Conduct Problems		
Dimensional	3.58	9%
Categorical	1.88	1%
Attention Deficit Problems		
Dimensional	3.61	17%
Categorical	2.64	4%

More generally, the above results suggest that for the sample being studied both conduct disorder and attention deficit measures had generally dimensional properties in which levels of symptomatology ranged from none to severe and that classifying these variables according to DSM III-R criteria led to a quite serious loss of explanatory and predictive power. Clearly in this instance, and for the sample being studied, measures based on a dimensional model of conduct disorder and attention deficit behaviours appear to have greater predictive validity than measures based in DSM III-R criteria and accordingly it would appear to be preferable to use the dimensional model as a means of measuring variations in conduct disorder and attention deficit symptoms under these circumstances.

Are Conduct Disorder and Attention Deficit Behaviours Different Aspects of Child Behaviour or Are They Merely the Same Aspect of Child Behaviour Measured in Different Ways?

The second question addressed in this analysis concerns the extent to which conduct disorder and attention deficit behaviours reflect different aspects of childhood behaviour. To the extent that the results above suggest that a dimensional model of childhood behaviour has greater predictive validity, the most effective way of addressing this question is through techniques of confirmatory factor analysis. We have presented a full analysis of this issue previously [39] and the account below gives a summary of the major findings of this analysis.

Table 3 shows the matrix of correlations between dimensional measures of conduct disorder and attention deficit observed at age nine. In this matrix, measures of conduct disorder and attention deficit have been obtained from up to three sources: maternal report, teacher report and child report. For conduct disorder measures there are reports from all three sources whereas for attention deficit measures only maternal and teacher report data are available. Inspection of Table 3 reveals the following conclusions:

a) Measures of the same construct derived from different sources are only modestly correlated. For example, teacher and maternal reports of conduct disorder are correlated +.35 suggesting only modest relationships between maternal and teacher reports of the extent to which the child was prone to conduct disorder. Similarly, maternal and teacher reports of attention deficit are correlated only +.46 again suggesting quite considerable disagreement between maternal and teacher accounts of attention deficit behaviours.

b) Measures of different constructs reported by the same source are, however, quite strongly correlated. For example, teacher reports of conduct disorder are correlated +.78 with teacher reports of attention deficit and maternal reports of conduct disorder are correlated +.56 with maternal reports of attention deficit.

These results suggest the presence of a complicated state of affairs in which the same constructs measured by different methods are only moderately correlated but in which different constructs measured by the same method are quite strongly correlated.

Table 3: Matrix of polychoric correlations for measures of conduct disorder and attention deficit (9 years).

	CONDUCT DISORDER			ATTENTION DEFICIT	
	Maternal Rating	Teacher Rating	Child Rating	Maternal Rating	Teacher Rating
CONDUCT DISORDER					
Maternal rating	1.000				
Teacher rating	0.352	1.000			
Child rating	0.242	0.229	1.000		
ATTENTION DEFICIT					
Maternal rating	0.558	0.394	0.226	1.000	
Teacher rating	0.323	0.775	0.189	0.461	1.000

To explain the structure of the correlations in Table 3 we proposed a model which had the following general properties:

a) Firstly, it was assumed that the observed variables reflected two underlying factors with one of these factors corresponding to the child's generalised tendency to conduct disorder and the other corresponding to the child's generalised tendency to attention deficit behaviours.

b) To account for the fact that reports from different sources were only moderately correlated, it was assumed that reports from a specific source were subject to sources of error including both test unreliability and method specific variation.

c) Finally, to account for the fact that measures of different constructs described by the same sources were quite strongly correlated, it was assumed that errors of measurement of reports of child behaviours provided by the same source were correlated as a result of common method specific factors.

The model fitted is depicted in Figure 1. In this model all coefficients are expressed in standardised form and may be interpreted as follows:

a) The coefficients linking the observed test scores to the latent factors of conduct disorder and attention deficit are estimates of the correlations between the observed tests and the non-observed factors. These measures thus provide indices of the validity of the observed variables as measures of the latent factors. It may be seen that there is evidence to suggest quite considerable fallibility in the observed variables as measures of the latent constructs. The correlations between observed measures of conduct disorder and the latent construct of conduct disorder range from .38 to .60, whereas the correlations between the observed measures of attention deficit and the latent factor of attention deficit range from .62 to .74. These results suggest that somewhere in the region of 14% to 55% of the variance in the observed reports reflects the child's general behavioural tendencies and the remaining variation arises from other sources including test unreliability and method specific factors.

b) There is evidence to suggest that conduct disorder and attention deficit factors are highly correlated with the estimated correlation between these factors being +0.87.

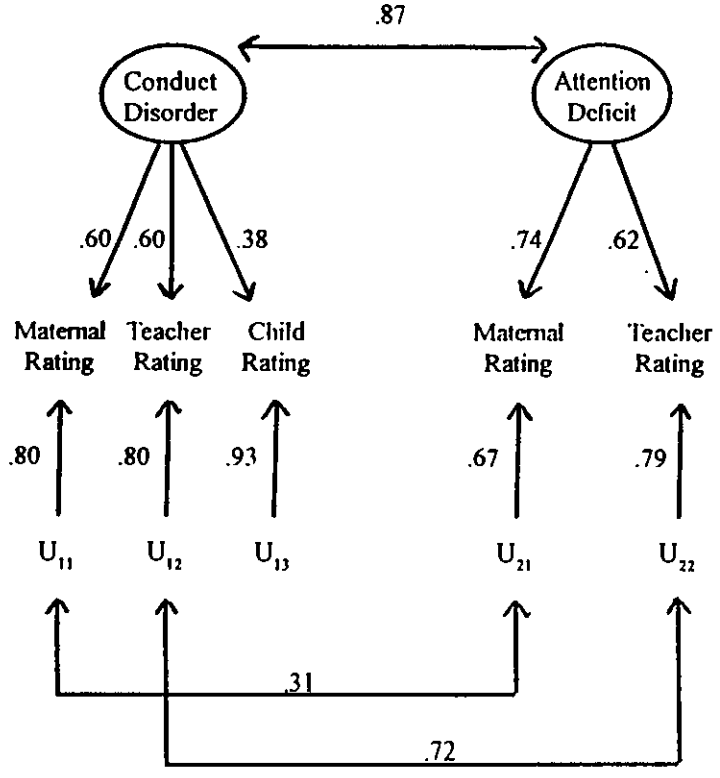
c) Finally, there is evidence of a strong tendency for the errors or disturbances of the model to be correlated. Errors in maternal reports are correlated in the region of 0.31 and errors in teacher reports are correlated in the region of 0.72. These correlations clearly suggest the presence of method or situation specific variation in reports of child behaviour.

More generally, the fitted model in Figure 1 suggests that whilst maternal, teacher and child reports of behaviour reflect two underlying dimensions of child behaviours, these dimensions are highly correlated and that there are substantial sources of error in the observed report data.

An important feature of the confirmatory factor model techniques is that they make it possible to test the hypothesis that conduct disorder and attention deficit behaviours are distinct albeit correlated dimensions of child behaviour. This may be

done by contrasting the goodness of fit of a model which assumes two factors with a model which assumes that all reports describe a single common factor. This approach leads to a chi square test of whether conduct disorder and attention deficit behaviours reflect two separate but correlated factors or whether they, in fact, reflect a single common factor. Applied to the present data this method showed that whilst a two factor model fitted the data adequately, a single factor model did not fit the data and that the assumption of two factors significantly improved the fit of the model ($\chi^2_1 = 24.4$; $p<.001$). It may therefore be concluded that the data are not consistent with a single factor model but fit a two factor model adequately. This evidence is clearly consistent with the view that conduct disorder and attention deficit are distinct albeit correlated dimensions of childhood behaviour.

Figure 1: Fitted two factor model of the relationship between measures of conduct disorder and attention deficit (9 years).



The Longer Term Consequences Of Early Conduct Disorder and Attention Deficit Behaviours

The results thus far suggest that conduct disorder and attention deficit behaviours for this sample appeared to have generally dimensional properties in which the extent of problem behaviours ranged from none to severe. The analysis also suggested that conduct disorder and attention deficit behaviours are distinct albeit correlated aspects of childhood behaviours. However, whilst these findings are of general interest as a description of the properties of reports of conduct disorder and attention deficit, for the constructs of conduct disorder and attention deficit to be scientifically useful it is necessary to show that these behaviours have different developmental consequences. As we have observed earlier there is evidence to suggest the presence of highly specific relationships between early behaviour and later outcomes. In general this evidence suggests that early conduct disorder in the absence of attention deficit behaviours is associated with later antisocial behaviour but is unrelated to later academic performance whilst early attention deficit in the absence of conduct disorder is associated with later academic problems but not with later antisocial behaviour.

To examine this issue further, the structural equation modelling approach used to examine the validity of the distinction between attention deficit and conduct disorder was extended to examine the relationships between attention deficit and conduct disorder behaviours at age eight years and juvenile offending and scholastic performance at age 13 years. The full analysis of this issue will be described in a forthcoming publication [42] and here we will limit the presentation to the major findings of the analysis.

The major findings of this analysis are shown in the path model depicted in Figure 2. This model shows the relationships between measures of conduct disorder and attention deficit at age eight and offending behaviours and scholastic performance at age 13 years. The coefficients shown in this diagram are standardised parameter values and may be interpreted in a way which is similar to standardised regression coefficients or correlations. The model shows that early conduct disorder and attention deficit are related to later outcomes at age 13 years in the following ways.

Firstly, as shown in the earlier analysis, conduct disorder and attention deficit at the age of eight years were highly correlated variables ($r = +.79$). Secondly, the model assumes that early conduct disorder is related to later offending but is unrelated to later scholastic performance. The fitted coefficients show that there is, in fact, very strong continuity between conduct disorder behaviours at age eight years and offending at age 13 ($\beta = .81$). (It may be noted that the correlations between conduct problems at age eight and offending at age 13 shown in Figure 2 are far stronger than the correlations shown in Table 1. The reason for this difference is that the model in Figure 2 contains corrections for errors of measurement in reports of behaviour and reports of offending whereas the results in Table 1 are not corrected for these errors).

Thirdly, the model assumes that early attention deficit behaviours are related to later scholastic performance but are not related to later offending. The fitted

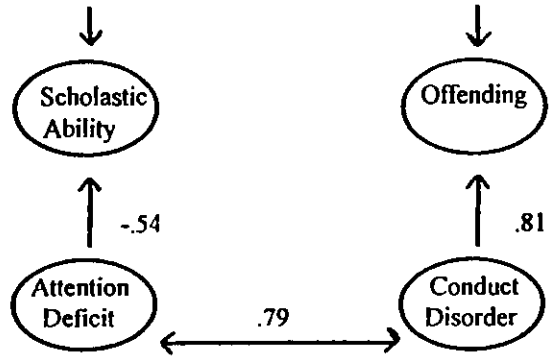
coefficients show the presence of relatively strong relationships (ß =-.54) between the child's tendencies to attention deficit at age eight years and later academic performance implying that high levels of attention deficit at age eight were associated with impaired scholastic performance at age 13.

Perhaps the most important features of the model in Figure 2 concern the relationships which are not present. In particular the model shows:

a) Early conduct disorder is unrelated to later scholastic performance: any correlation between conduct disorder and scholastic performance arises because conduct disorder is associated with attention deficit behaviours and attention deficit behaviours are associated with academic performance.

b) Early attention deficit is unrelated to later offending: any association between early attention deficit behaviours and later offending arises because attention deficits are correlated with conduct disorder behaviours which, in turn, are associated with later offending.

Figure 2: Fitted structural equation model of attention deficit and conduct disorder at age eight years and offending and scholastic ability at age 13 years.



More generally, the absence of associations between conduct disorder and scholastic performance or between attention deficit and offending suggest that conduct disorder and attention deficit behaviours during middle childhood have different developmental consequences. Conduct disorder in the absence of attention deficit behaviour is associated with increased risks of later offending but not with increased risks of academic failure whereas attention deficit in the absence of conduct disorder is associated with increased risks of academic failure but not with increased risks of young offending. The fitted model thus suggests the presence of two parallel but correlated developmental sequences which link early behaviours to later outcomes. In one sequence early conduct disorder is a precursor of later offending behaviours but is unrelated to later academic achievement whereas in the other sequence early attention deficit is a precursor of later academic problems but is unrelated to later offending behaviours.

To the extent that the analysis suggests that conduct disorder and attention deficit behaviours in isolation have different developmental consequences, the findings in Figure 2 provide strong construct validation of the distinction between conduct disorder and attention deficit behaviours. Not only can conduct disorder and attention deficit behaviour be shown to be distinct albeit correlated aspects of childhood behavioural development but also these behaviours have different longer term developmental consequences with conduct disorder being associated with later offending but not with later academic achievement and attention deficit being associated with later academic achievement but not with later offending.

DISCUSSION

In this research we have looked at three general issues relating to the interpretation and validity of measures of conduct disorder and attention deficit during middle childhood. The major findings of this analysis may be summarised as follows:

Scales or Categories

There is little doubt that the analysis here clearly supports the view that for the purpose of predicting later offending or academic performance in a general child population, dimensional models of conduct disorder and attention deficit behaviours had superior predictive validity to models based on standardised diagnostic criteria. The reasons for the greater predictive superiority of the dimensional model are clear from the analysis. In general, mean scores on tests of scholastic performance and risks of offending showed generally consistent trends to increase with the increasing severity of conduct disorder or attention deficit symptoms. The effects of dichotomising this distribution by imposing diagnostic criteria which distinguish between cases and non-cases was to lose information about the continuous dose relationship between behavioural tendencies and later outcomes and this loss of information was reflected in a loss or predictive power of the dichotomous model. This loss of power resulted in relative risk measures based on the DSM III model being consistently lower than the relative risk estimates for the continuous model and also in the amount of variance explained by the categorical model being substantially smaller than the variance explained by the dimensional model.

However, whilst in this instance, a dimensional model has substantial predictive superiority over a categorical model based on DSM III-R criteria this does not imply that this conclusion will invariably hold. Several points need to be considered. Firstly as a number of authors [44,45,46] have pointed out, the dichotomy of "scales versus categories" may be misleading to the extent that the distribution of childhood behaviours may reflect both categorical and dimensional components. This point has been well illustrated in a recent analysis of childhood hyperactivity reported by Taylor and his associates [46]. In this analysis, the authors found that measures of childhood hyperactivity contained both dimensional and categorical components. In particular,

they identified a broad dimensional measure of hyperactivity which was similar to the attention deficit measure reported in this paper and in which levels of symptomatology appeared to range continuously from none to severe. However at the extremes of this distribution they identified a small group of the population (about 1.7% of children) who were subject to a specific hyperkinetic syndrome. These children were not simply children with extreme hyperactivity scores but were children who differed qualitatively from the rest of the child population. It seems very likely that many measures of childhood psychopathology will have the properties found in the analysis reported by Taylor et al with most of the variation in symptom levels being accounted for by broad dimensional models but at the extremes of the distribution there may be groups of children who suffer qualitatively different behaviour disturbances which do not simply represent extremes of a continuous distribution.

For these reasons, it seems likely that the choice of measurement system in terms of scales or categories is likely to vary with the population being studied. In general population samples, such as the sample studied here, most of the variation in symptomatology is likely to represent variations in broad dimensional variables describing the child's general predispositions to such behaviours as conduct disorder or attention deficit. However, within clinical populations in which children are selected for high levels of symptoms, it may be that most of the variation reflects qualitative rather and quantitative differences in levels of disorder. Within such samples categorical and diagnostic measures of symptomatology may be more informative.

A second point that needs to be borne in mind is that whilst the present study has shown that for the purposes of predicting offending and school performance during adolescence a dimensional model is clearly superior, it does not follow that a dimensional model will be superior in predicting all outcomes. It may be that for some outcomes and particularly highly pathological outcomes, a diagnostic categorical model may be superior to a dimensional model.

The above remarks emphasize the point made by a number of previous authors. [44,45,46] that the issue of scales or categories is not a matter which can be solved by a simple uniform methodological decision to use one approach or the other. To the extent that measures of child behaviour are likely to contain both dimensional and categorical components, the choice of measurement method needs to be determined by careful consideration of the type of sample being studied and the type of research issue being confronted. It would seem that this is better achieved by comparing the statistical properties of the two approaches applied to a given sample and research problem using techniques similar to those employed in this paper rather than by the current and unfortunate tendency to resolve such matters by fiat through the claim that a particular measurement method should be applied in all studies.

Are Conduct Disorder And Attention Deficit Measures Of The Same Thing Observed In Different Ways?

The second question addressed in this analysis concerned the extent to which conduct disorder and attention deficit measured the same or different aspects of child behaviour. Application of confirmatory factor analysis methods showed that conduct disorder and attention deficit behaviours were two distinct but highly correlated measures of behaviour with the correlations between these measures being in the region of .80. These results explain the reasons for the on-going debate about whether conduct disorder and attention deficit behaviour are distinct aspects of childhood behavioural variation since it is clear that with two highly correlated trait variables there is considerable latitude to debate whether these variables measure the same behaviours or different behaviours.

The power of the confirmatory factor models used in this paper is that they provide the foundations of statistical hypothesis testing methods which make it possible to test formally whether there is a single factor of general problem behaviour or distinct but correlated factors of attention deficit and conduct disorder. The results of this testing show quite clearly that there are two distinct factors and that statistically conduct disorder and attention deficit cannot be treated as measuring the same type of childhood behavioural variation.

Do Early Conduct Disorder And Early Attention Deficit Have Different Developmental Consequences?

The issues examined above are largely based on conclusions drawn from the analysis of the properties of symptoms of conduct disorder and attention deficit and suggest that these behaviours contain strong dimensional properties and that there appear to be distinct albeit highly correlated dimensions of conduct disorder and attention deficit behaviours. However, for the distinction between conduct disorder and attention deficit to be useful it must be shown that not only can distinct dimensions of conduct disorder and attention deficit be discriminated on the basis of the analysis of symptom level data but also these behaviours have different longer term developmental consequences.

The results presented in the paper, in fact, provide quite strong construct validation of the distinctions between conduct disorder and attention deficit by showing that not only are these behaviours different dimensions of child behavioural variation but also the developmental consequences of conduct disorder and attention deficit in isolation are different. The model in Figure 2 suggests the presence of two distinct albeit correlated development progressions in the relationship between early childhood behaviour and later development. The first developmental progression appears to describe the development of social conformity and social adjustment. In this sequence early conduct disorder is a predictor of later offending and anti-social behaviours but early conduct disorder is not related to later academic performance.

The second developmental progression appears to involve the development of cognitive/attentional skills. In this sequence early attention deficit behaviours are prognostic of future academic and scholastic performance. These two sequences appear to be quite distinct and are correlated only by virtue of the fact that conduct disorder and attention deficit behaviours are correlated. These results have a number of important theoretical and clinical implications.

First, as noted above, the findings that conduct disorder and attention deficit in isolation have different developmental consequences provides strong validation of the distinction between conduct disorder and attention deficit behaviours. Not only can conduct disorder and attention deficit be shown to be different dimensions or aspects of childhood behavioural variation but also the developmental consequences of these behaviours differ with conduct disorder being a precursor of later social and adjustment but not later academic achievement and attention deficit being a precursor of later academic achievement but not later social adjustment.

Secondly, the results suggest that what has often been seen as a single developmental sequence in which early problems are associated with later problems is likely to be two quite different but correlated developmental sequences with one sequence involving the process of acquisition of social adjustment and the other the acquisition of cognitive/attentional skills.

Thirdly, the results have clear clinical implications to the extent that they suggest that the prognosis of children with early externalising disorders is likely to depend on the mix of conduct disorder and attention deficit symptomatology displayed by the child. In general children with high levels of conduct disorder symptomatology but low levels of attention deficit behaviour are likely to be at high risk of later offending and other anti-social behaviours but are not at increased risks of problems of academic under-achievement or failure. On the other hand children with high levels of attention deficit symptomatology but with low levels of conduct disorder symptoms are likely to be at high risk of academic failure but are not at risk of offending or anti-social behaviour. Finally, the children who show a mix of both high conduct disorder and high attention deficit symptoms are likely to be at risk of both offending behaviour and academic failure. It is clear from this that to adequately assess externalising behaviours during childhood requires careful assessment of the relative mix of conduct disorder and attention deficit symptoms shown by the child.

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