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The Origins of Comorbidities Between Conduct
and Affective Disorders

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ABSTRACT

Objective: This analysis employed methods of structural equation modelling to assess the extent to which comorbidities between conduct and affective disorders could be explained by: a) common or correlated causal factors that influenced both outcomes; b) reciprocal causation between these conditions.

Method: Data were obtained during the course of a 16 year longitudinal study of a birth cohort of New Zealand children. The data analyzed comprised measures of conduct and affective disorders at ages 15 and 16 and data on a series of antecedent childhood factors.

Results: Structural equation modelling suggested that a substantial component of the comorbidity between conduct and affective disorders arose because the risk factors associated with the development of conduct disorders in teenagers overlapped and were correlated with the risk factors for adolescent affective disorders: of the shared variance between conduct disorder and affective disorders over two thirds was explained by common risk factors. These conclusions were replicated using diagnostically scored measures and methods of categorical data analysis. Model extensions suggested an absence of direct causal pathways between conduct and affective disorders.

Conclusions: A substantial amount of the correlation and comorbidity between conduct and affective disorders arises because the risk factors and life pathways that predispose adolescents to one outcome are also associated with the risk factors and life pathways that predispose adolescents to the

other outcome. Nonetheless, even after control for common causal factors there was evidence of some unexplained comorbidity between conduct and affective disorders.

In recent years there has been growing interest in the comorbidity between conduct disorders (conduct disorder, oppositional defiant disorder) and affective disorders (major depression, dysthymia) in adolescent populations (Angold and Costello, 1993; Zoccolillo, 1992). Two lines of evidence support the view that these disorders are comorbid so that the presence of one disorder is associated with an increased risk of the other disorder. First, a series of studies based on clinic samples has shown that, amongst those with conduct disorders, risks of affective disorder are elevated or, that amongst those with affective disorders, risks of conduct disorders are increased (Alessi and Magen; 1988; Chiles et al., 1980; Harrington et al., 1991; Kovacs et al., 1988; Marriage et al., 1986; Puigh-Antich, 1982). However, these studies provide a fallible guide to comorbidity since comorbidity in clinic samples may arise from sample selection biases that increase the likelihood that those with multiple disorders are included in clinic samples (Angold and Costello, 1993; Caron and Rutter, 1991; Zoccolillo, 1992). Nonetheless, evidence from population based studies has confirmed the presence of comorbidities between affective and conduct disorders. In a review of four population based studies Zoccolillo (1992) found that adolescents with conduct disorders had higher rates of affective disorders than those without conduct disorders. Similarly, in a review of eight community based studies, Angold and Costello (1993) reported higher rates of conduct disorders amongst those with an affective disorder.

While the comorbidity between affective and conduct disorders is well documented, the origins of this comorbidity

remain unclear. Possible explanations of the association between affective disorders and conduct disorders have been proposed by Zoccolillo (1992) and by Angold and Costello (1993). Leaving aside explanations that ascribe this association to methodological artefacts, the proposed explanations appear to be variants of three accounts of the origins of this comorbidity. These explanations are:

Causally Antecedent Factors. First, it may be proposed that the comorbidities between affective and conduct disorders arise because the risk factors and life pathways that are associated with an increased vulnerability to one condition are also associated with increased risks of the other condition. As Caron and Rutter (1991) have noted, there are two ways in which antecedent causal factors may lead to comorbidity. First, the risk factors for one disorder may be common with the risk factors for the other disorder. Second, whilst two disorders may have apparently different risk factors, these risk factors may be correlated with each other. In both instances the comorbidity between disorders arises because the risk factors and life pathways that lead to one disorder overlap or are correlated with the risk factors and life pathways that lead to the other disorder. There is some evidence to support this hypothesis as the literature on risk factors for conduct and affective disorders has identified a number of risk factors including social disadvantage, adverse life events, marital conflict and parental mental illness that may be common to both sets of conditions (Angold, 1988; Farrington et al., 1990; Fleming and Offord, 1990; Patterson et al., 1989).

   Direct Causal Relationships. The second explanation is
that the presence of one condition acts to influence or
increase susceptibility to the other condition. For example,
it may be suggested that conduct disorder may set in train a
series of events including police contact, parental disapproval
and peer rejection that increase the likelihood that those
showing conduct disorders will develop affective disorders
(Patterson and Capaldi, 1990; Rhode et al., 1991). There are
three types of direct causal association that may exist between
affective and conduct disorders. First, conduct disorder may
be a direct cause of affective disorder. Secondly, affective
disorder may be a direct cause of conduct disorder (Kovacs et
al., 1988; Puigh-Antich, 1982). Finally, affective and conduct
disorders may be reciprocally related so that the presence of
conduct disorder causally influences risks of affective
disorder while, at the same time, the presence of affective
disorder causally influences risks of conduct disorders.

   Common Syndrome Explanations. The third explanation of
comorbidity between conduct and affective disorders is that
this comorbidity reflects the presence of a common syndrome.
Two possible common syndrome explanations may be proposed.
Firstly, it may be suggested that individuals showing comorbid
disorders experience a specific syndrome of conduct/affective
disorder that is distinct from conduct disorder or affective
disorder in isolation (Zoccolillo, 1992). Secondly, it may be
suggested that these comorbidities arise because these
conditions reflect a general syndrome reflecting the
individual's generalised vulnerability to psychiatric disorder

which is manifest in comorbidities between different types of disorder (Zoccolillo, 1992).

While a number of theoretical explanations of the origins of the comorbidity between affective and conduct disorders have been proposed, relatively few studies have set out to systematically test the hypotheses set out above. In this paper we use data from a 16 year longitudinal study and methods of structural equation modelling to examine the extent to which this association arises from: a) common or correlated causal factors that predispose individuals to both outcomes and b) potentially reciprocal causal relationships in which the presence of one condition causally influences risks of the other condition.

Theoretical and Statistical Background.

To motivate the proposed analysis consider a study in which longitudinal measures of conduct and affective disorders have been obtained on at least two occasions with these observations being supplemented by prospective measures of known risk factors for the two conditions. Assume that measures of conduct and affective disorders are scored as continuous variables in which the severity of disorder ranges from none to severe. Under these conditions the comorbidities between the two conditions can be expressed in terms of the extent of correlation between the dimensionally scored variables. Figure 1 presents two possible models of the origins of the correlation between affective and conduct disorder variables:

Model 1 (Figure 1a) assumes that this correlation arises from common or correlated risk factors that predispose

individuals to both affective and conduct disorder. This model assumes that, when known risk factors measured antecedent to the outcome measures are taken into account, there is no correlation between affective and conduct disorder measures. Model 2 (Figure 1b) gives a longitudinal extension of model 1 which includes measures of conduct and affective disorders at two times. This model permits the examination of potential reciprocal causation between affective and conduct disorder variables. This model assumes that:

i) The individual's level of conduct disorder at time 2 is a function of his/her pre-existing level of conduct disorder at time 1 and known risk factors for conduct disorder.

ii) The individual's level of affective disorder at time 2 is a function of his/her pre-existing level of affective disorder at time 1 and known risk factors for affective disorder.

iii) Conduct disorder and affective disorder measured at time 2 are reciprocally related so that the individual's score on one measure is directly related to his/her score on the other measure.

iv) Finally, the model permits conduct disorder and affective disorder to be correlated independently of common causal influences and reciprocal patterns of influence between scores.

Subject to the assumption that all relationships between variables can be represented by a linear and additive model, the conceptual models shown in Figures 1a, 1b can be represented as a system of linear structural equations and fitted to the matrix of correlations (or variances and

covariances) of the measures of conduct disorder, affective disorder and the common risk factors. Further, it should be noted that it is possible to fit the model in Figure 1a using categorically scored measures to estimate the relationships between conduct disorder and affective disorder after common risk factors have been taken into account. However, the more complex model shown in Figure 1b cannot be tested using dichotomously scored measures of disorder since it is not possible to fit models of simultaneous reciprocal causation using dichotomous measures (Fienberg, 1980).

INSERT FIGURE 1 HERE

In the remainder of this paper we will use data gathered during the course of a 16 year longitudinal study of a birth cohort of New Zealand children to examine:

i) The extent to which correlations between affective disorder and conduct disorder measures can be explained by common risk factors that are associated with both outcomes by fitting the model in Figure 1(a) to data gathered on conduct disorders and affective disorders at ages 15, 16 years and a series of prospectively measured risk factors.

ii) The extent to which correlations between affective and conduct disorder measures can be explained by both common causal processes and patterns of reciprocal causation by fitting the model shown in Figure 1(b) to data on affective and conduct disorder measures at ages 15, 16 years and the series of common risk factors.

METHOD

The data reported here were collected during the course of the Christchurch Health and Development Study. The Christchurch Health and Development Study is a longitudinal study of a birth cohort of 1265 children born in the Christchurch (New Zealand) urban region during mid 1977. These children have been studied at birth, four months, one year and annual intervals to the age of 16 years using data collected from parental report; teacher report; self-report and official record data. An overview of the study design has been given previously (Fergusson et al., 1989). The data analyzed in this report were measured in the following ways.

Symptoms of Affective (Major depression, dysthymia) and Conduct (Conduct disorder, oppositional defiant disorder) at 14 to 15 years and 15 to 16 years.

At ages 15 and 16 years parental and self reports of symptoms of affective (major depression, dysthymia) and conduct (conduct disorder, oppositional defiant disorder) disorders during the preceding year were collected using questionnaires which combined items from the parent and self report versions of the Diagnostic Interview Schedule for Children (DISC; Costello et al., 1982) and the Self Report Early Delinquency Scale (SRED; Moffitt and Silva, 1988) supplemented by further items based on DSM-III-R diagnostic criteria for major depression. From this questioning, it was possible to construct DSM-III-R symptom measures for the following diagnostic groupings: a) conduct disorder; b) oppositional defiant disorder; c) major depression; d) dysthymia. These

symptom measures were used to construct both continuously and diagnostically scored variables:

Conduct Disorders. To measure the extent to which the young person exhibited symptoms of conduct or oppositional defiant disorder over the periods from 14 to 15 years and 15 to 16 years, symptom scores were constructed by summing the number of DSM-III-R symptoms of these disorders reported by respondents and their parents. The reliability of these scores, as assessed by coefficient alpha, was .86 for both the period 14 to 15 and 15 to 16.

Conduct disorder symptoms were also classified to form dichotomous diagnostic measures of whether the young person met DSM-III-R diagnostic criteria for either conduct disorder or oppositional defiant disorder on the basis of self or parentally reported symptoms. Using this classification, 10.8% of the sample were classified as having a conduct or oppositional defiant disorder during the interval from 14 to 15 years and 11.6% were classified in this way for the period 15 to 16 years. An account of the construction of these diagnostic classifications has been given previously (Fergusson et al., 1993).

Affective disorders. To measure the extent to which the young person exhibited affective symptoms during the period from 14 to 15 years and 15 to 16 years, symptom scores were constructed by summing the number of DSM-III-R symptoms of major depression and/or dysthymia reported by the respondent and his/her parents. The reliability of the symptom scores, assessed by coefficient alpha, was .85 for the period 14 to 15 years and .86 for the period 15 to 16 years.

In addition, affective symptoms were classified to form dichotomous diagnostic measures of whether or not the young person met DSM-III-R criteria for major depression or dysthymia on the basis of self reported or parentally reported symptoms during the periods 14 to 15 years and 15 to 16 years. On this basis 6.6% of the sample were classified as having an affective disorder during the interval 14 to 15 years and 9.5% as having an affective disorder during the interval 15 to 16 years. An account of the construction of DSM-III-R diagnoses of affective disorder for this sample has been given previously (Fergusson et al., 1993).

<u>Common Social and Contextual Factors</u>.

To adjust the associations between affective disorders and conduct disorders for the effects of common risk factors, a range of prospectively measured social, family, individual and peer factors was included in the analyses. These factors were selected on the basis of previous analyses of this data set (Fergusson et al., 1994; Fergusson et al., in press), and the availability of measures within the database, and included the following:

<u>Conduct problems (8 years)</u>. This was assessed using parental and teacher reports of conduct disordered or oppositional behaviors based on items derived from the Rutter (Rutter et al., 1970) and Conners (Conners, 1969; 1970) parent and teacher questionnaires. These measures were combined to produce a measure of the extent to which the young person was reported to show conduct disordered or oppositional behaviors (Fergusson et al., 1991). The reliability of this scale, as measured by coefficient alpha, was .93.

Intelligence (8 years). This was assessed at the age of eight years using the Wechsler Intelligence Scale for Children - Revised (WISC-R; Wechsler, 1974). The full scale score, which had a mean of 102.54 and standard deviation of 14.88, was used in this analysis and was found to have good reliability (α = .93).

Affiliations with delinquent peers (14 years). To measure the extent to which the young person affiliated with delinquent or substance using peers at age 14, a general index of peer affiliations was constructed. This index was based on self reports of the extent to which the young person's best friend and other friends: used tobacco, alcohol and cannabis, truanted or broke the law. These items were combined to produce a scale measure of the extent to which the young person reported affiliations with delinquent or substance using peers (Fergusson and Horwood, in press). The resulting scale was of moderate internal consistency (α = .76).

Marital conflict. Parents were questioned annually on three items which described the quality of marital relationships. These items were: a) whether the parents had engaged in prolonged arguments during the last 12 months; b) whether the child's mother had been assaulted by her spouse in the last 12 months; and c) whether the child's mother reported experiencing sexual difficulties in the last 12 months. These items were combined over the period from birth to 10 years to form an index of the extent to which the child was exposed to parental discord during this time. The construction of this scale has been described previously (Fergusson et al., 1992).

Family life events. Each year from 11 to 14 years parents

were questioned about life events occurring in the previous year using a 49 item life event inventory based on the inventory developed by Henderson et al (1981). To produce a global measure of the extent of family exposure to adverse life events, reports of life events over the four year period were summed.

Family history of offending. At age 15 years the young person's parents were asked if they, or the young person's siblings had a record for criminal offending. On the basis of responses to this questioning 10.5% of the sample were classified as having a family history of offending.

Parental attachment. Parental attachment was assessed at age 14 years using the parental attachment scale developed by Armsden and Greenberg (1987). The full parental attachment scale was used in this analysis and this scale was found to have good reliability ($\alpha = .87$).

A series of additional measures of social, family and individual characteristics was also considered for inclusion in the analyses. These measures included measures of family social background, maternal depression, family and childhood adversity, parental substance use behaviors and self esteem. However, these factors were not included in the analyses reported as the results of preliminary analyses indicated that they did not make any direct contributions to variations in affective or conduct disorders.

Sample Size

While the study reported here was based on a birth cohort of 1265 children, the analyses reported here were based on a

sample of 934 respondents for whom there was complete data for affective and conduct disorders at ages 15 and 16 years. This sample represented 73.8% of the initial cohort of children and 84.1% of the sample alive and resident in New Zealand at the age of 16 years. To examine the effects of sample losses on the sample representativeness, comparisons were made of the socio-demographic characteristics of the 934 subjects included in the analysis with the 331 subjects excluded from the analyses. This suggested that losses to follow up during the course of the study were not associated with child ethnicity, gender, maternal age or family size. There were, however, small but statistically detectable tendencies (p<.05) for the sample to under-represent children from families in which mothers lacked formal educational qualifications, families of low socioeconomic status and single parent families.

<center>RESULTS</center>

<u>The Correlations and Comorbidities between Affective and Conduct Disorder Measures</u>.

Table 1 shows the matrix of correlations between measures of conduct disorder and affective disorder symptoms during the periods 14 to 15 years and 15 to 16 years. This Table suggests the following conclusions:

i) There was relatively strong stability (r = +.67) of conduct disorder scores between ages 14 to 15 and 15 to 16.

ii) There was moderate continuity (r = +.47) between affective disorder scores between ages 14 to 15 and 15 to 16 years. iii) There was moderate comorbidity (r = +.22 to +.35) between conduct disorder and affective disorder scores.

INSERT TABLE 1 HERE

An Antecedent Cause Model of the Correlation between Affective and Conduct Disorder Measures.

To examine the extent to which the correlations between affective disorder and conduct disorder measures in Table 1 were explained by common risk factors that were antecedent to both outcomes, causal models of the form shown in Figure 1(a) were fitted to the matrix of correlations between conduct and affective disorder measures and a series of common risk factors. Table 2 shows the matrix of correlations between the measures of affective disorder, conduct disorder and the prospectively measured risk factors.

INSERT TABLE 2 HERE

Two models were fitted to the data in Table 2. In the first model the correlation between conduct disorder and affective disorder measures during the period 14 to 15 years was predicted from the effects of the common risk factors. In the second model, a similar model structure was used to predict the correlation between affective and conduct disorder measures during the period 15 to 16 years. Model fitting was conducted using LISREL 8 (Joreskog and Sorbom, 1993) and methods of maximum likelihood estimation. Table 3 shows:

i) Estimates of the standardized regression coefficients between the risk factors and each outcome for each fitted model.

ii) The multiple correlations between the risk factors and each outcome variable.

iii)   A decomposition of the total correlation between
conduct disorder and affective disorder into the component of
correlation explained by common risk factors and the
unexplained component of correlation.

Inspection of Table 3 leads to the following conclusions:

i) At both 14 to 15 and 15 to 16 years, measures of
affective disorders and conduct disorders were related to a
series of common risk factors including adolescent peer
affiliations, parent-child relationships, life events, early
conduct problems, intelligence, family conflict, family history
of offending and gender. These results indicate that both
types of outcome were influenced by a set of common or
correlated factors.

The extent to which the risk factors for conduct disorder
were correlated with the risk factors for affective disorder
was assessed in the following way. For each subject an
estimate of his/her expected conduct disorder or affective
disorder score was formed by solving the regression model for
that subject. The resulting scores ranked the sample from
those having high risks of conduct disorder or affective
disorder to those having low risk. The two sets of scores were
then correlated. This analysis revealed the presence of a
strong (r + .65) correlation between the risk factors
associated with conduct disorder and the risk factors
associated with affective disorder. This correlation reflected
the facts that: a) the risk factors for the two disorders
tended to overlap (see Table 3) and b) nearly all risk factors
considered were significantly correlated (see Table 2).

ii)   The multiple correlation estimates suggest that

moderate prediction of adolescent outcomes was possible on the basis of prospectively measured risk factors. The multiple correlations between the risk factors and conduct disorder measures were in the region of .48 to .54 and the multiple correlations between risk factors and affective disorder measures were in the region of .37 to .39.

iii) Finally, the Table suggests that a substantial component of the correlation between conduct and affective disorder measures was explained by the antecedent risk factors. At 14 to 15 and 15 to 16 years this correlation was in the region of .34 to .35. Of this correlation between .13 to .15 was explained by the effects of the common risk factors and the remaining correlation was unexplained. This result implies that a substantial component of the common variance shared by affective and conduct disorder measures was explained by common causal factors: before adjustment for common causes the shared variance in affective disorder and conduct disorder scores was in the region of 12% whereas after adjustment the shared variance was in the region of 4%. Nonetheless, after adjustment for common causal factors, the unexplained correlations between affective disorder and conduct disorder scores remained statistically significant ($p < .001$).

INSERT TABLE 3 HERE

Extension to Consider Possible Reciprocal Causation between Affective and Conduct Disorder Measures.

The results in Table 3 suggest that not all of the correlation between measures of affective and conduct disorders could be explained by the influence of common causal variables.

This raises the possibility that there may be direct causal associations between affective and conduct disorders independently of the effects of common causal factors. To examine this issue the analysis was extended by fitting the model of reciprocal causation shown in Figure 1(b) to the data in Table 2. Again, model fitting was conducted using methods of maximum likelihood estimation and LISREL 8.

The results of this analysis are summarized in Table 4 and lead to the following conclusions:

i) Measures of conduct and affective disorders at age 16 were strongly related to the lagged measures of these constructs and somewhat diffusely related to other antecedent risk factors.

ii) When the lagged measures and antecedent risk factors were taken into account, the reciprocal pathways between conduct and affective disorders were both small and statistically non-significant (p>.05). This result implies that, when due allowance was made for the antecedent factors, there was no evidence to suggest direct causal linkages between conduct and affective disorders.

iii) Finally, the fitted model shows that, even when due allowance was made for both causally antecedent factors and direct causal pathways between conduct and affective disorders, there was evidence of a modest unexplained correlation between conduct and affective disorders (r = .14, p<.001). The above results may be summarized by noting that the fitted model suggests that the correlation between conduct and affective disorders arises from two sources: a) causally antecedent factors associated with these outcomes; b) unexplained sources

of correlation, and that there is no evidence to suggest direct causal linkages between conduct disorder and affective disorder.

INSERT TABLE 4 HERE

Tests of Model Robustness/Sensitivity.

The model above was fitted to data on a total sample of subjects using product moment correlations and methods of maximum likelihood estimation. Further, the analysis did not take into account possible errors of measurement in the variables analyzed. To examine the extent to which the analysis was sensitive to the effects of: a) gender differences; b) methods of estimation; and c) measurement errors, a series of models was fitted to the data to take account of gender variation (by fitting separate models for males and females), estimation (by using different methods of estimation: maximum likelihood, weighted least squares) and by taking account of measurement errors in response variables through the use of multiple indicator methods. All analyses led to a similar set of conclusions to those reported above: a) a substantial amount of the correlation between conduct and affective disorder measures was explained by antecedent risk factors; b) there was no evidence of direct causal linkages between conduct and affective disorders; c) after adjustment for antecedent factors there were still significant correlations between affective and conduct disorders.

Analysis of Categorical Data.

The major conclusion of the above analysis was that a substantial component of the comorbidity between conduct disorder and affective disorder could be explained by common risk factors that influenced both outcomes. It was possible to test this explanation using categorically scored variables by estimating the odds ratio between conduct disorders and affective disorders before and after adjustment for the effects of common risk factors. Adjustment of the odds ratio was achieved by fitting a logistic model in which the log odds of affective disorder was modelled as a function of conduct disorder and the common risk factors. The results of this analysis are summarized in Table 5 which gives estimates of the odds ratios between affective and conduct disorders at ages 14 to 15 and 15 to 16 years before and after adjustment for common causal factors.

This analysis produced conclusions that are analogous to the conclusions drawn for dimensionally scored variables. Before adjustment the odds ratios between affective and conduct disorders were in the region of 3.6 to 4.7. After adjustment for the common causal factors these odds ratios reduced to between 2.6 to 2.7.

INSERT TABLE 5 HERE

DISCUSSION

This paper has documented the comorbidities between affective and conduct disorders in a birth cohort of New Zealand children studied to the age of 16 years and has

developed statistical models to examine alternative explanations of this comorbidity. The major findings and conclusions of this analysis are described below.

In confirmation of the findings of previous studies (Alessi and Magen, 1988; Angold and Costello, 1993; Chiles et al., 1980; Harrington et al., 1991; Kovacs et al., 1988; Marriage et al., 1986; Puigh-Antich, 1982; Zoccolillo, 1992), there was evidence of clear comorbidity between affective and conduct disorder symptoms. This association was reflected in the fact that dimensionally scored measures of affective and conduct disorder symptoms were correlated in the region of .35 and the analysis of categorically scored measures suggested odds ratios between these two sets of disorders that were in the region of 3.6 to 4.7.

Possible explanations for the origins of this comorbidity were examined by fitting a series of structural equation models to estimate the extent to which these associations arose from: a) the effects of common or correlated risk factors that were associated with increased vulnerability to both disorders; b) direct causal associations between conduct and affective disorders. This analysis suggested that a substantial component of the correlation between conduct and affective disorders arose because the risk factors and life pathways that were associated with increased vulnerability to conduct disorders overlapped and were correlated with the risk factors and life pathways associated with vulnerability to affective disorders. When the effects of common or correlated risk factors were taken into account the correlation between affective and conduct disorders was reduced from .34 to between

.20 to .21. Similar conclusions were reached when the data
were analyzed using categorical measures of disorder.

The principle reason for these results was that the risk
factors for conduct and affective disorders either: a)
overlapped with each other or b) the risk factors for different
disorders were intercorrelated. The net effects of the inter-
correlation and overlap of risk factors for the two disorders
was that the risk factors for conduct disorder were strongly
correlated (r = +.65) with the risk factors for affective
disorder. This result suggests that the risk factors and life
pathways that led to increased risks of conduct disorder had
much in common with the risk factors and life pathways for
affective disorders.

The analysis was extended to examine the extent to which
reciprocal causation existed between conduct disorder and
affective disorder symptoms. Model fitting suggested that any
direct causal pathways between conduct disorders and affective
disorders were both weak and statistically non-significant.
Decomposition of the correlations between conduct and affective
disorders suggested that over two thirds of the shared variance
between these disorders could be explained by known common or
correlated causes and that one third was unexplained by the
model. There was no evidence to suggest that direct causal
relationships were implicated in the association.

The unexplained component of correlation found between
conduct disorder and affective disorder in this analysis can be
explained in two ways. First, it may be suggested that this
correlation arises because statistical control for antecedent

factors associated with affective and conduct disorders was less than perfect to the extent that the model may have omitted common causal variables that could explain the remaining correlation. For example, an omission from this analysis involved data on common genetic factors that may be associated with both increased risks of affective disorder and increased risk of conduct disorder. It is also possible that the family and individual factors measured in this study did not include all antecedent factors that might give rise to correlations and comorbidities between conduct and affective disorders. For these reasons, the estimates given in this paper are likely to produce lower limit estimates of the amount of correlation between affective and conduct disorders that can be ascribed to the effects of antecedent factors.

An alternative explanation is that the residual unexplained correlation may reflect the presence of a common syndrome independently of the common causes. It might, for example, be proposed that the residual association arises because the correlation between affective and conduct disorders reflects a more general tendency to psychiatric disorder or that this association reflects the presence of a number of individuals who have a comorbid disorder of conduct/affective disorder that is different from conduct disorder or affective disorder in isolation (Angold and Costello, 1993; Zoccolillo, 1992).

While the emphasis of this analysis has been upon developing a theoretical account of the origins of the comorbidity between conduct and affective disorders, the findings may have some clinical application and implications. In particular, the conclusions of the analysis may be restated

by observing that a major reason for the comorbidity between
affective and conduct disorders arose because the antecedent
personal, family and related factors which give rise to conduct
disorders were ''cormorbid'' with personal, family and related
factors that contributed to affective disorders. The
implication of these results is that in the treatment and
management of children with comorbid affective and conduct
disorders considerable attention needs to be paid to the extent
to which this comorbidity arises from generally unsatisfactory
or compromised childhood circumstances and, of course, finding
ways and means of overcoming the impact of these circumstances
on the individual's risks of both conduct and affective
disorder.

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Figure 1(a). <u>Model of Cormorbidity Between Affective and
Conduct Disorders Assuming That Comorbidity Can Be Explained By
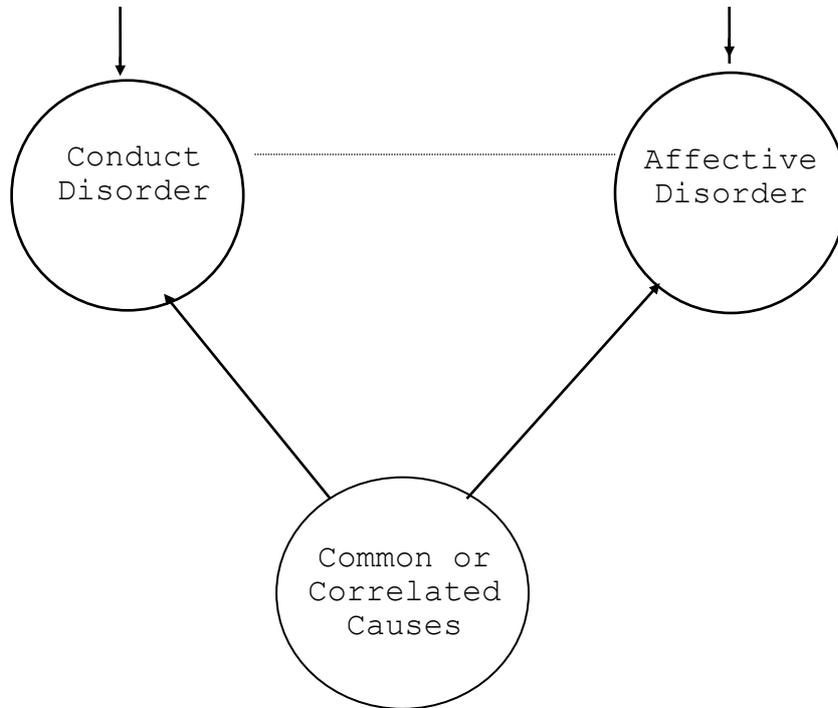The Influence of Common or Correlated Causes</u>

Figure 1(b). <u>Model of Comorbidity Between Affective and</u>
<u>Conduct Disorders Assuming That Comorbidity Arises From: (A)</u>
<u>Common or Correlated Causal Factors; (B) Reciprocal Causation</u>
<u>and (C) An Unexplained Component Of Correlation</u>
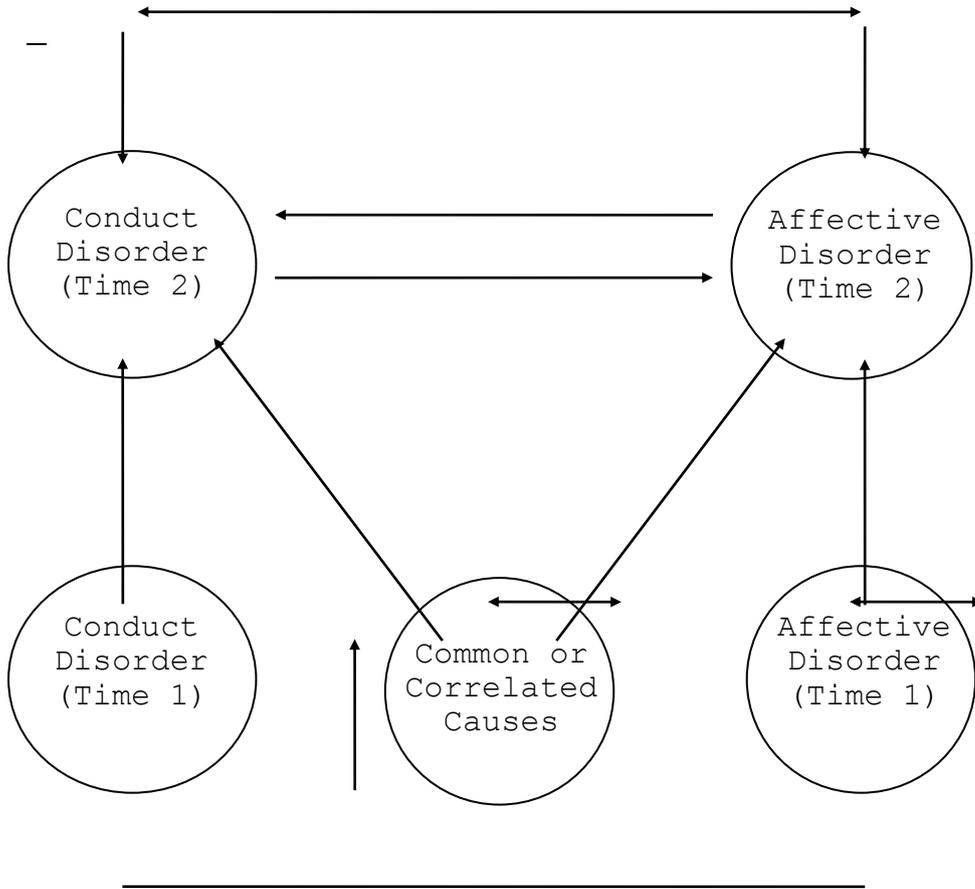
Table 1. <u>Matrix of Correlations of Continuously Scored</u>

<u>Measures of Affective and Conduct Disorder Symptoms 14 to 15</u>

<u>and 15 to 16 Years</u>

	14 to 15 YEARS		15 to 16 YEARS	
	Conduct Disorder	Affective Disorder	Conduct Disorder	Affective Disorder
14 to 15 Years				
Conduct Disorder	1.00			
Affective Disorder	0.35	1.00		
15 to 16 Years				
Conduct Disorder	0.67	0.22	1.00	
Affective Disorder	0.27	0.44	0.34	1.00

N = 934

Table 2. <u>Matrix of Correlations Between Affective, Conduct Disorder Measures At 14 to 15, 15 to 16</u>

<u>Years and Antecedent Risk Factors</u>

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
V1	1.00											
V2	.35	1.00										
V3	.67	.22	1.00									
V4	.27	.44	.34	1.00								
V5	.37	.21	.29	.22	1.00							
V6	−.33	−.24	−.28	−.24	−.34	1.00						
V7	.27	.25	.21	.25	.19	−.15	1.00					
V8	.47	.09	.44	.14	.21	−.26	.24	1.00				
V9	−.24	−.13	−.27	−.12	−.09	.08	−.13	−.29	1.00			
V10	.31	.18	.27	.21	.16	−.13	.32	.31	−.19	1.00		
V11	.24	.16	.25	.18	.14	−.08	.26	.27	−.18	.32	1.00	
V12	−.05[a]	.20	−.08	.21	.04[a]	−.07	.03[a]	−.21	−.03[a]	−.02[a]	.00[a]	1.00

Note: V1 = Conduct disorder score (14 to 15 years); V2 = Affective disorder score (14 to 15 years);
V3 = Conduct disorder score (15 to 16 years); V4 = Affective disorder score (15 to 16 years); V5 =
Affiliations with delinquent peers (14 years); V6 = Parental attachment (14 years); V7 = Life events
(11 to 14 years); V8 = Conduct problems (8 years); V9 = Intelligence (8 years); V10 = Family
conflict; V11 = Family history of offending; V12 = Gender.

[a] Correlation not significantly different from zero (p>.05)

Table 3. <u>Summary of Fitted Common Cause Models For the Comorbidity of Affective and Conduct</u>

<u>Disorder Measures at 14 to 15 Years and 15 to 16 Years</u>

a) Standardized Model Coefficients

Predictor	14 to 15 Year Outcomes		15 to 16 Year Outcomes	
	Conduct Disorder	Affective Disorder	Conduct Disorder	Affective Disorder
Affiliations with delinquent peers (14 years)	.22	.10	.15	.11
Parental Attachment (14 years)	-.16	-.16	-.14	-.14
Life Events (11 to 14 years)	.10	.17	.04[a]	.15
Early Conduct Problems (8 years)	.23	-.04[a]	.22	.01[a]
Cognitive Ability (8 years)	-.07	-.06[a]	-.12	-.04[a]
Family Conflict	.07	.05[a]	.05[a]	.05[a]
Family History of Offending	.08	.07	.10	.08
Gender	-.02[a]	.13	-.04[a]	.14
Multiple Correlation	.54	.39	.48	.37

[a] Coefficient not significantly different from zero (p>.05)

Table 3. continued

b) Decomposition of correlation between affective and conduct
disorder measures

Component of Correlation	14 to 15 Years	15 to 16 Years
Total correlation	.35	.34
Correlation explained by common causes	.15	.13
Unexplained correlation	.20	.21

Table 4. <u>Standardized Regression Coefficients for the Model for</u>

<u>the Comorbidity of Affective and Conduct Disorder Measures at</u>

<u>15 to 16 Years Including Reciprocal Direct Effects</u>

Variable	Conduct Disorder 15 to 16 Years	Affective Disorder 15 to16 Years
<u>15 to 16 Year Measures</u>		
Conduct disorder	--	.08[a]
Affective disorder	-.02[a]	--
<u>Common/Correlated Predictor Variables</u>		
Conduct disorder (14 to 15 years)	.51	*[b]
Affective disorder (14 to 15 years)	*[b]	.33
Affiliations with delinquent peers (14 years)	.04[a]	.07
Parental attachment (14 years)	-.06[a]	-.08
Life events (11 to 14 years)	-.01[a]	.09
Early conduct problems (8 years)	.11	.01[a]
Cognitive ability (8 years)	-.08	-.01[a]
Family conflict	.01[a]	.04[a]
Family history of offending	.06	.05[a]
Gender	-.03[a]	.10
Multiple correlation	.63	.51

[a] Parameter not significantly different from zero (p>.05)

[b] Parameter constrained to zero

Table 5. <u>Odds Ratios (95% Confidence Intervals) Between</u>
<u>Affective and Conduct Disorders Before and After Adjustment for</u>
<u>Covariates</u>

	14 to 15 Years	15 to 16 Years
Unadjusted Odds Ratio	3.6 (1.9-6.7)	4.7 (2.8-7.8)
Adjusted Odds Ratio	2.6 (1.4-5.1)	2.7 (1.5-5.0)
Significant Covariates	1-3	1-5

Significant Covariates:

1 = Gender; 2 = Parental attachment (14 years); 3 = Family history of offending; 4 = Affiliations with delinquent peers (14 years); 5 = Life events (11 to 14 years).