

The intergenerational transmission of conduct problems

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Running Head: Conduct Problems across Generations

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Abstract

Purpose: Drawing on prospective longitudinal data, this paper examines the intergenerational transmission of childhood conduct problems in a sample of 209 parents and their 331 biological offspring studied as part of the Christchurch Health and Developmental Study. The aims were to estimate the association between parental and offspring conduct problems and to examine the extent to which this association could be explained by a) confounding social/family factors from the parent's childhood and b) intervening factors reflecting parental behaviours and family functioning.

Methods: The same item set was used to assess childhood conduct problems in parents and offspring. Two approaches to data analysis (generalised estimating equation regression methods and latent variable structural equation modelling) were used to examine possible explanations of the intergenerational continuity in behaviour.

Results: Regression analysis suggested that there was moderate intergenerational continuity ($r=.23$, $p<.001$) between parental and offspring conduct problems. This continuity was not explained by confounding factors but was partially mediated by parenting behaviours, particularly parental over-reactivity. Latent variable modelling designed to take account of non-observed common genetic and environmental factors underlying the continuities in problems behaviours across generations also suggested that parenting behaviour played a role in mediating the intergenerational transmission of conduct problems.

Conclusions: There is clear evidence of intergenerational continuity in conduct problems. In part this association reflects a causal chain process in which parental conduct problems are associated (directly or indirectly) with impaired parenting behaviours that in turn influence risks of conduct problems in offspring.

Keywords: Conduct problems, intergenerational transmission, longitudinal studies, parenting.

Introduction

A growing number of studies have documented associations between the presence of externalising problems including conduct disorder and oppositional defiant disorder during the childhood of parents and the presence of these problems in their children [1-4]. For example Bailey et al., [5] examined the continuity of parenting styles and child externalizing behaviours across three generations. In line with Capaldi et al., [6] and Thornberry et al., [7], they found a significant association between parental externalizing behaviour at ages 13–14 and the later externalizing behaviour of their children at ages 6–14 (mean age 9). Similarly, Van Meurs and colleagues [8] showed the presence of intergenerational continuities from parents to their children for a broad range of problem behaviours.

The presence of linkages between parental adjustment during childhood and the adjustment of offspring has also been supported by behavioural genetic research which has suggested substantial heritability of conduct problems [9-12]. For example Rhee and Waldman [9] in their meta-analysis of 51 twin and adoption studies found that heritability accounted for 41% of the variability in antisocial behaviour. Similarly Tuvblad et al. [13] found that common genetic factors accounted for 61% of the variance in persistent antisocial behaviours in an analysis of 2,600 twin pairs studied from childhood to adulthood.

While there is now growing evidence for the inter-generational continuity of conduct problems, there are a number of issues which require further examination.

1. *The role of confounding factors*: One possible explanation of inter-generational continuities in externalising problems is that these arise from common social and contextual factors that may have influence on families across generations. These factors may include: i) parent's childhood and familial disadvantage (family SES, family living standards); ii) family of origin instability and conflict (changes of parents, exposure to inter-parental violence during childhood); iii) parental adjustment

(parental alcohol problems, criminality, illicit drug use, history of depression/anxiety); v) exposure to childhood physical and sexual abuse. All of these factors are associated with conduct problems in parents and could, in theory, confound the association between conduct problems in parents and in offspring. To demonstrate the presence of homotypical continuity between parental conduct problems and offspring conduct problems requires showing that these associations are persistent when social and contextual factors known to be associated with conduct problems are taken into account.

2. Identification of intervening factors: While the existence of intergenerational continuities in conduct problems has been well documented less is known about the extent to which these continuities are mediated by environmental factors relating to parental characteristics. Possible mediating factors include: parental age at childbirth, parental education, parental substance abuse, parental mental health, parenting styles and inter-partner conflict. All of these factors are known to be associated with a prior history of childhood conduct problems [14-23] and are also known to be related to the development of conduct problems in offspring [16,24-31].

More generally it may be suggested that parent /child continuity in conduct problems is a consequence of parental behaviours that are associated with conduct problems in parents and also increase the risks of conduct problems in offspring.

Against this background this study examines the intergenerational continuities in childhood conduct problems using data from 209 parents studied as part of the Christchurch Health and Development Study and their 331 biological children aged 3 years and older. The specific aims of this study are:

1. To confirm the association between parents' and their biological children's conduct problems.

2. To adjust this association for a wide range of confounding factors associated with parental childhood family disadvantage, family of origin instability and conflict, parental adjustment and child abuse.
3. To examine the role of a series of potentially intervening factors (parental age at childbirth; parental education; parental substance use/mental health; parenting style; family functioning) in mediating the association between conduct problems in parents and conduct problems in offspring.

Methods

Sample

Participants were members of a birth cohort that has been extensively studied as part of the Christchurch Health and Development Study (CHDS). The CHDS is a longitudinal study of 1,265 children born in the Christchurch (New Zealand) urban region during mid-1977 and followed until age 30 years [32]. Throughout the study, rates of participation have remained high and at age 30, 987 participants (80% of the surviving cohort) were assessed. At age 30, all cohort members who had become biological parents or who were parenting a non-biological child as a step or foster parent (N=397) were asked to take part in an additional parenting and family interview, of whom 360 (91%) agreed to participate. Analyses reported in this paper are based on the subsample of 209 cohort members (68 fathers and 141 mothers) who had become biological parents by age 30 and who were living with their 331 biological children aged 3 years or older (148 girls and 183 boys, mean age = 7 ± 2.9 , range 3-14 years). This comparison has been restricted to biological children aged 3 years and older on the basis that the range of behaviours selected and investigated in this study could not be detected in very young children. All data were collected with the signed consent of research participants and all phases of the study were subject to ethical approval from the regional ethics committee.

Assessment of child conduct problems in parents and their children

When cohort members were aged 7, 8 and 9 years, parent reports of their child's tendencies to disruptive, oppositional and conduct disordered behaviours were obtained using a selected set of items from the Rutter [33] and Conners [34] parent questionnaires. A total of 21 items were selected spanning disobedience, fits of temper and irritability, aggression and cruelty towards others, dishonesty, disturbing others and related behaviours. Previous analysis has shown that these items could be scaled as a unidimensional scale reflecting the severity of child conduct disordered and oppositional behaviours amongst cohort members as reported by their parents [35].

When cohort members were aged 30, participants who had become parents were asked to rate the extent of behaviour problems in each of their biological children using a scale that also combined items from Rutter [33] and Conners [34] parent questionnaires. These scales contained a similar series of items describing child tendencies to disruptive, oppositional and conduct disordered behaviours, with 18 items being the same as those used to previously assess their parents' behaviour. These 18 items were used as the common basis for the assessment of conduct problems in both parents and offspring to ensure consistency in the assessment of child conduct problems across generations.

Confirmatory factor analysis (CFA) was used to test the dimensionality of the selected item sets for assessing child conduct problems in both parents and their offspring. In each case, an item parcel approach was used in which the 18 items were first combined into a smaller number of item parcels, with CFA then being applied to the variance/covariance matrix of the item parcels. In both cases, the CFA showed that the item sets were consistent with an underlying unidimensional scale reflecting the extent of childhood conduct problems amongst parents and their offspring.

Scale score estimates of parents' conduct problems at age 7-9 were obtained based on an unweighted sum of the 18 items, with each item first averaged over reports obtained at ages 7, 8, 9

years. Internal consistency, assessed using coefficient alpha, was high ($\alpha = .90$). Scale score estimates for their children's conduct problems were based upon an unweighted sum of the 18 items for each of their offspring. Internal consistency for child behaviour problems was also high ($\alpha = .87$).

Confounding factors

A range of measures of the parent's childhood family circumstances were selected from the data base of the study to control for confounding by childhood social and family context. In all cases these factors were selected on the basis that they were known to be associated with parental conduct problems and potentially linked to conduct problems in offspring. These measures spanned the following domains:

Family socio-economic disadvantage

Four measures of family socio-economic disadvantage were considered. *Parent education levels* were assessed at the time of the cohort member's birth using a 3-point scale reflecting the highest level of education attained by the participant's mother and father. This scale was: no formal qualifications; high school qualifications; tertiary qualifications. *Family SES* at the time of the cohort member's birth was assessed using the Elley-Irving scale of socio-economic status for New Zealand [36]. Finally, a measure of *family material living standards* was constructed using interviewer ratings of family living standards that were obtained at annual intervals from when the cohort member was aged 1-10 years. Ratings were made of a 5-point scale from 1=obviously affluent to 5=very poor. These ratings were averaged over the 10 year period to provide a measure of the family's average standard of living over this period.

Family functioning

Three measures of family functioning were selected. First, the *number of changes of parents* experienced by the participant from birth to age 16 years was used as a measure of family instability

during the cohort member's childhood. Second, at age 18 cohort members were questioned using selected items from the Conflict Tactics Scale [37] to assess the extent to which they had witnessed incidents of inter-parental violence during their childhood (<16 years). These items were combined to derive scale measures of the extent of father-initiated ($\alpha = .86$) and mother-initiated ($\alpha = .77$) violence [38]. In the present analysis these scales were combined to provide an overall measure of the extent of exposure to *inter-partner violence*. Third, a measure of the extent of *parental adjustment problems* during the participant's childhood was constructed based on a sum of four dichotomous measures reflecting whether any parent had a reported history of: a) criminal offending; b) problems with alcohol; c) illicit drug use; d) problems with depression or anxiety. Parental reports of illicit drug use were obtained when participants were aged 11, and reports of the remaining problems when cohort members were aged 15.

Exposure to child physical and sexual abuse (0-16 years)

At ages 18 and 21 cohort members were questioned concerning the extent to which their parents used physical punishment during their childhood (<16years). Separate ratings were made for mothers and fathers. These ratings were combined into a single four point rating of exposure to *physical abuse* based on the most severe form of parental physical punishment reported at either age. This classification ranged from those whose parents never used physical punishment to those who reported that at least one parent used severe or frequent physical punishment [39].

At ages 18 and 21 cohort members were also questioned about their exposure to a range of unwanted sexually abusive experiences in childhood (<16years). Participants reporting such experience were further questioned about the nature and context of the abuse. Using these data participants were classified into four groups reflecting the most severe form of *sexual abuse* reported at either 18 or 21. This classification was: no reported sexual abuse; non contact abuse only; contact abuse not involving attempted or completed sexual penetration; attempted/completed oral, anal or vaginal intercourse [39].

Offspring characteristics

Three measures of the offspring characteristics were also taken into account: *child age, gender* and *birth order* in the family.

Intervening factors

Five domains of potential intervening factors were considered. These measures were chosen on the basis that they were known to be associated parental childhood conduct problems [14,30] and likely to be associated with increased risks of conduct problems in offspring.

Age at first parenthood

At each assessment from age 18 to 30 participants were questioned about their history of pregnancy or getting a partner pregnant and the outcome of any pregnancy since the previous assessment.

These data were used to define the participant's *age in years at first parenthood*.

Educational attainment

At every assessment from age 18-30 participants were questioned about their educational history and attainment of qualifications. Based on these data participants were classified on a 7 point scale reflecting the *highest level of educational attainment* by age 30 ranging from those with no qualifications to those with a university degree [40].

Partner relationships and family functioning (since birth of offspring)

At each assessment from age 21-30 years, participants were questioned about aspects of their partner relationships since the previous assessment, including their history of cohabiting partnerships, the occurrence of inter-partner violence and deviant partner behaviours. Reports of inter-partner violence were obtained using the Revised Conflict Tactics Scale [37] to assess the extent to which the participant had been the victim or perpetrator of inter-partner violence in the previous 12 months, supplemented by additional custom written items. In addition, a scale measure of partner deviance was obtained from participant reports of the extent to which their partner had

problems with aggression, alcohol or illicit drugs, engaged in illegal activities, had problems with the law, and related difficulties [41]. These data were used to define three measures reflecting the following aspects of family functioning as experienced by each child in the family: a) a measure of *family instability* was defined on the basis of the number of reported cohabiting partners since the birth of the child; b) a measure of *inter-partner violence* was defined based on the number of reported occurrences of inter-partner physical violence since the birth of the child; and c) a measure of *deviant partner affiliations* was defined based on the average partner deviance score for all reported partners since the birth of the child.

Parental mental health (since birth of offspring)

At each assessment from age 18-30 years participants were interviewed on a comprehensive mental health interview that combined components of the Composite International Diagnostic Interview [42] to assess DSM-IV symptom criteria for a range of disorders over the period since the previous assessment including: *major depression*; *anxiety disorder* (generalized anxiety disorder, panic disorders, agoraphobia, social phobia, specific phobia); *substance use disorders* (*alcohol*, *illicit drug dependence*). Participants were also questioned about suicidal behaviours. Using these data a measure of parental mental health problems was constructed for each child in the family based on a count of the number of mental health problems reported for each parent subsequent to the birth of the child.

Parenting practices

At age 30 parents were assessed on four measures of parenting style reflecting positive and negative aspects of parenting behaviours [30]: parental *warmth* assessed the level of affectionate care provided by the parent ($\alpha=.84$); parental *sensitivity* assessed the parent's ability to recognize and respond to their child's needs ($\alpha=.70$); *over-reactive child management* assessed the extent to which parents engaged in negative and over-reactive child management strategies –eg. responding with

anger, irritation or disapproval ($\alpha=.82$); *lax/inconsistent discipline* assessed the extent to which the parent exhibited passive or inconsistent behaviour management strategies ($\alpha=.76$).

Statistical methods

Association

The first stage of the analysis examined the association between the extent of parental childhood conduct problems at age 7-9 and mean conduct problems scores in their offspring stratified by birth order in the family (Table 1). To facilitate data display the measure of parental conduct problems was quantilised into four levels based on the distribution of the conduct problems score at age 7-9 years. These groups were: those with few or no problems whose scores placed them in the bottom 40% of the distribution (Group 1); those whose scores placed them in the 41st to 70th percentiles (Group 2); those whose scores placed them in the 71st to 90th percentiles (Group 3); and those with the highest conduct problems scores who fell into the 91st to 100th percentiles (Group 4).

The data in Table 1 were modelled using Generalised Estimating Equation methods [43] to fit a population averaged regression model to estimate the association between parents' conduct problems and children's conduct problems pooled over all children. The fitted model was of the form:

$$Y_{ij} = B_0 + B_1 X_j + U_{ij} \quad (\text{EQ1})$$

where Y_{ij} was the conduct problems score for the i th child of the j th parent; X_j was the quantilised measure of parental conduct problems at age 7-9 years for the j th parent; and U_{ij} was a disturbance term. In this model the parameter B_1 represents the linear effect of parent's conduct problems on their children's conduct problems. To examine whether this association varied with birth order (ie to test for a parental conduct problems by birth order interaction) this model was then extended to permit the slope parameter B_1 to vary with birth order i (B_{1i} , $i = 1, 2, 3+$). A Wald chi square test of

the equality of the parameters B1i was then used as a test for a parental conduct problems by birth order interaction.

Control for confounding

In the second stage of the analysis (Table 2) a series of GEE models was fitted to the data to control for confounding by aspects of the parent's childhood experience and family context. These models also included measures of child age, gender and birth order to control for child characteristics. In its most general representation this model was of the form:

$$Y_{ij} = B_0 + B_1 X_j + \sum B_k C_{kij} + \sum B_m Z_{mj} + U_{ij} \quad (\text{EQ2})$$

where C_k were variables representing child characteristics, Z_m were the set of confounding parental factors. For this analysis model fitting was conducted with the measure of parental conduct problems (X_j) scaled in its continuous metric described above, rather than the quantilised form used for the purposes of data display in Table 1. To examine the effect of the inclusion or exclusion of variables on the estimated parameter B1 model fitting was conducted by initially including all variables in the model and then successively refining the model to include only significant predictors. Since the parameter estimates for B1 were negligibly different for models that incorporated all predictors compared to those that included only significant predictors, the results below are based on models that incorporated only significant ($p < .05$) or marginally significant ($p < .10$) confounders.

Testing for mediation

The model in EQ2 was then extended to incorporate a series of potential intervening factors. This model had the general form:

$$Y_{ij} = B_0 + B_1 X_j + \sum B_k C_{kij} + \sum B_m Z_{mj} + \sum B_p I_{pj} + \sum B_q I_{qij} + U_{ij} \quad (\text{EQ3})$$

where I_{pj} were the set of intervening factors specific to the j th parent (age at first parenthood, education, parenting behaviours) and I_{qij} were the set of intervening factors defined relative to each

child (family functioning, parental mental health since the birth of the child). Again the model was successively refined to include only those intervening factors that made a significant net contribution to the prediction of child behaviour. Sobel tests [44] were then conducted for each of the significant intervening factors included in the final regression model to test for mediation of the association between parental and offspring conduct problems.

All GEE models were fitted using Stata 10 [45] and assuming an unstructured matrix for the correlation of child behaviour problems within families.

Latent variable modelling

Finally, to provide a reinterpretation of the regression model, the latent variable model in Figure 1 was fitted to the data. Model fitting was conducted using Mplus [46] and methods of maximum likelihood estimation that were robust to the multilevel nature of the data (repeated observations on children within families). Model goodness of fit was assessed via the model log likelihood chi square statistic, the Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA) and the Standardised Root Mean Squared Residual correlation (RMSR). In well fitting models the CFI should be close to one, the RMSEA less than .05 and the RMSR close to zero [47].

Results

Intergenerational continuity of conduct problems

Table 1 shows the associations between parental conduct problems assessed at 7-9 years and measures of conduct problems in offspring. For purposes of data display the parental conduct problems measure has been quantilised into four groups based on the distribution of the conduct problems score. These groups range from those in the least disturbed 40% of parents to those in the most disturbed 10%. Mean offspring conduct problems are reported for each level of parental

conduct problems and for each child, stratified by birth order in the family. The Table also reports the association between parental conduct problems and offspring conduct problems pooled across all eligible children.

A population averaged GEE model was fitted to the data in Table 1 (see Methods). This model led to the following conclusions:

1. There was a highly significant linear association between parental conduct problems and conduct problems in offspring ($p < .001$). The correlation between the extent of parental conduct problems and conduct problems in offspring was 0.23.
2. There was no significant parental conduct problems x birth order interaction ($p > .60$) suggesting that a linear additive model was an appropriate way of analysing the data.
3. The population averaged means in Table 1 show that children whose parents scored in the highest 10% of the childhood conduct problems scores had mean conduct scores that were .65 standard deviations higher than children whose parents scored in the least disturbed 40% of parents.

INSERT TABLE 1 ABOUT HERE

Adjustment for confounding factors

One explanation of the parent child continuities in Table 1 is that these may reflect continuities in other factors (eg socio-economic disadvantage) which may influence conduct problems rather than a specific association between parental and offspring conduct problems. To examine this issue the analysis was extended to control the association between parent and child conduct problems for a series of (potentially) confounding variables reflecting social and family contextual factors from parental childhood that were known to be correlated with parental conduct problems. These

variables spanned measures of: a) socio-economic disadvantage; b) family instability and conflict; c) parental adjustment and d) child abuse (see Methods). The fitted model also included measures of child age, gender and birth order to control for offspring characteristics.

Table 2 reports the fitted regression parameters for the unadjusted model (model a) and the model adjusted for confounding factors (model b). To simplify presentation the reported covariate adjusted results are based on a reduced model that incorporated only those factors making a significant ($p < .05$) or marginally significant ($p < .10$) contribution to the prediction of child conduct problems. The estimate of the adjusted parameter for parental conduct problems was unaffected by dropping out non-significant confounding factors from the full covariate adjusted model. For these models the measure of parental conduct problems has been scored in its continuous metric as described in Methods rather than in the quantilised form used for illustration in Table 1.

Examination of the Table shows:

1. Adjustment for confounding factors resulted in a modest reduction in the regression coefficient for parental conduct problems from 0.28 to 0.25. After adjustment for confounders the association between parental conduct problems and offspring conduct problems remained statistically significant ($p < .005$).
2. Significant confounding factors included childhood exposure to inter-partner violence ($p < .05$) and being raised by parents characterised by multiple personal adjustment problems ($p < .10$). In addition, offspring conduct problems were significantly higher for male children ($p < .005$), reflecting the well-known fact that boys tend to exhibit higher rates of conduct problems than girls.

INSERT TABLE 2 ABOUT HERE

Inclusion of intervening factors

The regression model in Table 2 was then extended to consider the role of possible intervening factors. These factors included a series of parental behaviours and characteristics that could theoretically increase or decrease risks of conduct problems in children and spanned the following domains: age at first parenthood; academic achievement; family functioning and partner relationships following the birth of each child; parental mental health following the birth of the child; and parenting behaviours (see Methods).

Analysis showed that of all the intervening factors, whether considered individually or jointly, only two factors made significant net contributions to the prediction of offspring conduct problems. Both of these factors (parental over-reactivity and lax/inconsistent discipline) reflected a negative parenting style. The fitted model incorporating significant confounding and intervening factors is shown in the right hand column of Table 2 (model c).

The Table shows that once intervening parenting characteristics were taken into account there was a further substantial reduction in the regression coefficient for parental conduct problems from 0.25 to 0.18. Application of mediation tests [48] showed that of the two parenting measures, only parental over-reactivity met all of the criteria for mediation of the association between parental and offspring conduct problems. Specifically: parental over-reactivity was significantly related to parental conduct problems ($p < .05$); parental over-reactivity significantly predicted offspring conduct problems ($p < .001$); the inclusion of parental over-reactivity resulted in a substantial reduction in the regression coefficient for the effect of parental conduct problems on offspring problems; and application of a Sobel test showed that the indirect path from parental conduct problems to offspring conduct problems via parental over-reactivity was statistically significant ($p < .05$).

While the effect of parental conduct problems was significantly mediated via parental over-reactivity nevertheless the regression coefficient for parental conduct problems remained statistically significant ($p < .05$) suggesting the presence of intergenerational continuity independently of confounding and intervening processes.

In summary the findings of this analysis suggest that:

1. There was modest continuity between parental conduct problems and conduct problems in offspring ($r=.23$; $p <.001$)
2. This continuity persisted after control for confounding factors ($p <.005$)
3. The association between parental and offspring conduct problems was partially mediated by parental over-reactivity. This result is consistent with a model in which: a) parental conduct problems are associated with increased parental over-reactivity; b) increased parental over-reactivity exacerbates conduct problems in offspring.

The influence of parent gender and child gender

To examine the extent to which findings varied by gender of child or gender of parent the models in Table 2 were extended to include: a) a parental conduct problems by parent gender interaction ; b) a parental conduct problems by offspring gender interaction; c) a parental conduct problems by parent gender by offspring gender interaction. In all cases these interactions were statistically non-significant, suggesting that the continuity between parent and offspring conduct problems did not vary with parent or child gender.

A latent variable interpretation

A limitation of the regression modelling approach above is that it fails to take into account the effects of non-observed genetic and environmental factors that may account for intergenerational continuities in behaviour. To address this issue Figure 1 provides a latent variable reinterpretation of the regression model c in Table 2. This model assumes that:

1. Parental Conduct Problems (η_1), Adjustment Problems in Grandparents (η_2), Parenting Behaviours of Parents (η_3) and Conduct Problems in Offspring (η_4) form a series of latent variables. Grandparent Antisocial Behaviour (η_2) is indicated by the observed measures of

grandparent inter-partner violence and adjustment problems. Parenting Behaviour (η_3) is indicated by the observed measures of parental over-reactivity and lax/inconsistent discipline. For the measures of Parent and Offspring Conduct Problems (η_1 , η_4) the reported behaviour scores were divided into split half measures to form the indicators for the latent constructs.

2. The latent measures of Parental Conduct Problems, Adjustment Problems in Grandparents and Offspring Conduct Problems in turn load on a Common Family Influences factor (η_5) representing non-observed common genetic and environmental factors underlying the associations between grandparental, parental and offspring tendencies to antisocial and problem behaviours.
3. The Common Family Influences factor (η_5) is also assumed to be related to Parenting Behaviour in the parent (η_3) which in turn is permitted to influence conduct problems in offspring (η_4).

This model showed a good fit to the data: $LR\chi^2(15)=11.0$, $p=0.75$; CFI=1.00; RMSEA=.000; SRMR=.023. Figure 1 shows the standardised parameters for the fitted model, and has the following interpretation.

1. There was a clear and significant pathway ($\beta= 0.65$, $p<.001$) from the Common Family Influences factor (η_5) to Parenting Behaviours (η_3) representing the effects of familial tendencies to antisocial and problem behaviours on parenting.
2. There was also a clear and significant pathway ($\beta= 0.50$, $p<.001$) from Parenting Behaviours (η_3) to Offspring Conduct Problems (η_4), reflecting the influence of parenting practices on child behaviour.
3. There was a smaller and non-significant direct pathway ($\beta= 0.30$, $p >.20$) from the Common Family Influences factor (η_5) to Offspring Conduct Problems (η_4).

In general, this model is consistent with the conclusion that the common genetic and environmental factors underlying familial tendencies to antisocial/problem behaviours lead to impaired parenting behaviours which in turn increase risks of conduct problems in offspring.

INSERT FIGURE 1 ABOUT HERE

Discussion

In this paper we have used two approaches to exploring the intergenerational continuity between parental conduct problems and conduct problems in offspring using data gathered over the course of a 30 year longitudinal study.

The first approach used Generalised Estimating Equation methods to examine three issues:

1. *Intergenerational continuity*: In agreement with previous research [5-8] we found evidence of moderate continuity ($r = 0.23$; $p < .001$) between conduct problems measured in parents at ages 7-9 years and conduct problems in offspring. An advantage of the study was that conduct problems in parents and in offspring was measured using the same instruments and test items thus ensuring that like was being related to like. These findings add to a growing body of evidence suggesting the presence of modest continuities between externalising behaviour in parents and in offspring [9-11,13].

2. *Control for confounding*: One possible explanation of the continuities between parent and offspring conduct problems is that these continuities reflect a more general tendency for childhood problems to be transmitted across generations rather than specific (homotypical) continuity between parental and child conduct problems. To examine this issue, efforts were made to control the association for a large number of covariate factors related to parental conduct problems. The covariates included parental childhood disadvantage, family of origin instability and conflict, grandparental adjustment and exposure to child abuse. Despite the use of a large number of

covariate factors, the analysis identified only two potential confounding factors, with both of the measures relating to the behaviour of the grandparents of the offspring: inter-partner violence; adjustment problems.

Further, even after both significant and non-significant confounding factors had been taken into account there was still a substantial association between conduct problems in parents and conduct problems in offspring. These findings support the conclusion that the association between parental and offspring conduct problems involves the specific homotypical transmission of behavioural adjustment across generations.

3. *Intervening processes*: One explanation of the continuity between parental conduct problems and child conduct problems is that parents with conduct problems may act in ways that encourage and reinforce the development of conduct problems in off spring. To test this hypothesis we examined the role of a wide range of factors that could possibly mediate the relationship between conduct problems in parents and in offspring. For most of the measures studied there was no evidence of mediation. However two variables were identified that could play an intervening role in the association between parent and child conduct problems. Both of these measures related to parenting behaviours with one of these meeting all of the criteria for mediation. This measure was parental over-reactivity which describes the extent to which parents engage in negative and reactive parenting strategies such as responding with anger, irritation and the use of bad language. These findings suggest that one route which may contribute to the continuity between parental conduct problems and conduct problems in children is a social learning process in which: a) parental conduct problems in childhood lead to increased rates of parental over-reactivity; b) exposure to parental over-reactivity increases risks of childhood conduct problems. This account is highly consistent with the social learning processes that Patterson and his colleagues [49] claim underlie the development of conduct problems in children.

An important limitation of the regression modelling approach above is that it fails to take into account non observed genetic and environmental factors that may account for the continuity between parental conduct problems and conduct problems in offspring. To address this concern a latent variable model was developed. The key assumptions of this model were that:

1. Measures of antisocial behaviours in grandparents, conduct problems in parents and offspring were treated as indicators of a latent Common Family Influences factor representing non observed common genetic and environmental factors that influenced behavioural adjustment across generations.
2. This Common Family Influences factor was also assumed to influence parenting behaviours in the parent.
3. In turn, parenting behaviours were permitted to influence offspring conduct problems.

This model, thus, permitted conduct problems in offspring to be influenced by two general processes. The first was by a direct effect of non-observed familial factors on conduct problems and antisocial behaviours across generations. The second was by a causal chain process in which the Common Family Influences factor was assumed to influence parenting behaviours which in turn influenced childhood conduct problems.

The results of this analysis showed the presence of a strong causal chain process in which the latent Common Family Influences factor influenced parenting behaviours which, in turn, lead to increased rates of conduct problems in children. This pathway strongly suggests the presence of a process in which conduct problems were transmitted from generation to generation by a social learning process in which antisocial behaviours in parents and grandparents were associated with impaired parenting skills in parents which led to increased rates of conduct problems in offspring. In addition there was a quite substantial but non-significant pathway ($\beta = .30, p > .20$) linking the latent Family Influences factor to offspring conduct problems. While the coefficient is non-significant its

size suggests that the possibility of a direct pathway from the Common Family Influences factor to conduct problems in offspring cannot be discounted.

Overall, both the regression analysis and the latent variable model produced results consistent with the view that one important component of the continuity between parental conduct problems and conduct problems in offspring is through a social learning process in which parental conduct problems are (directly or indirectly) associated with impaired parenting behaviours which in turn lead to conduct problems in offspring. However, for both analyses there is the possibility that the pathway between parenting and conduct problems in offspring may be overestimated since this association may reflect the facts that : a) impaired parenting behaviours in parents may encourage conduct problems in offspring ; while at the same time b) conduct problems in offspring may encourage impaired parenting behaviour in offspring.

Despite these uncertainties the present analysis leads to the following general conclusions:

1. There is clear evidence of a moderate continuity between conduct problems in parents and conduct problems in offspring.
2. This association in part reflects a causal chain process in which antisocial behaviours parents are (directly or indirectly) associated with impaired parenting which is associated with increased risks of conduct problems in offspring. This conclusion was evident for both the regression model which took into account observed confounders and the latent variable model that took into account non observed family factors associated with antisocial behaviours in grandparents, parents and offspring.
3. The regression modelling approach also suggested that conduct problems in parents were associated with conduct problems in offspring independently of the causal chain process described above. However, the results of the latent variable modelling approach were ambiguous. While there was a substantial regression coefficient from the latent factor to the off spring conduct problems this coefficient was non-significant.

In general these findings support the view that one important pathway by which parental conduct problems leads to conduct problems is via a causal chain process in which antisocial behaviours in parents and grandparents lead to impaired parenting which in turn leads to increased risk of conduct problems in offspring. The presence of this pathway is underwritten by a very substantial body of research which has shown that parent behaviour management training is effective in reducing rates of childhood conduct problems [50-53] suggesting an important role of the parenting environment in the inter-generational transmission of conduct problems. More detailed research using genetically informative designs is needed to trace further genetic and environmental factors that may be involved in this process.

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Table 1. Mean (SD) child conduct problems scores by birth order in family and extent of parental conduct problems (age 7-9 years).

		Parental Childhood Conduct Problems (7-9 Years)				
		Group 1 Low (1-40%)	Group 2 (41-70%)	Group 3 (71-90%)	Group 4 High (91-100%)	
Birth Order						
First born children	Mean (SD)	9.13 (7.19)	9.98 (6.11)	13.33 (8.00)	13.36 (8.46)	
	N	61	61	54	25	
Second born children	Mean (SD)	9.27 (7.37)	12.22 (6.78)	11.58 (6.18)	15.47 (6.42)	
	N	26	31	24	15	
Third or later born children	Mean (SD)	10.57 (6.58)	9.83 (7.20)	12.29 (5.09)	13.00 (6.39)	
	N	7	12	7	8	
All eligible children	Mean (SD)	9.28 (7.13)	10.63 (6.46)	12.75 (7.30)	13.96 (7.48)	p <.001
	N	94	104	85	48	

Table 2. Summary of fitted regression models for the association between parental and offspring conduct problems (a) unadjusted, (b) adjusted for child characteristics and significant confounding factors, (c) adjusted for significant confounders and intervening factors.

Measure	(a) Unadjusted		(b) Adjusted for confounding		(c) Adjusted for confounding and intervening factors	
	B (SE)	p	B (SE)	p	B (SE)	p
Parental conduct problems (7-9 years)	0.28 (.09)	<.001	0.25 (.09)	<.005	0.18 (.07)	<.05
<u>Child characteristics</u>						
Male gender			1.84 (.59)	<.005	1.46 (.59)	<.05
<u>Confounding factors (from parents' childhood)</u>						
Inter-partner violence (in grandparents)			0.39 (.15)	<.05	0.23 (.13)	.08
Adjustment problems (in grandparents)			0.81 (.48)	.09	0.39 (.41)	.35
<u>Intervening factors</u>						
Parental over-reactivity					2.49 (.48)	<.001
Lax, inconsistent parenting					1.60 (.45)	<.001
Marginal R ²	.05		.10		.32	

Figure 1. Fitted structural equation model of the role of underlying common family influences in explaining intergenerational continuities in behavioural adjustment. (Non-significant path indicated by dashed line.)

