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## Bidirectional Associations Between Externalizing Behavior Problems and Maladaptive Parenting Within Parent-Son Dyads Across Childhood

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### Abstract

Coercive parent–child interaction models posit that an escalating cycle of negative, bidirectional interchanges influences the development of boys’ externalizing problems and caregivers’ maladaptive parenting over time. However, longitudinal studies examining this hypothesis have been unable to rule out the possibility that between-individual factors account for bidirectional associations between child externalizing problems and maladaptive parenting. Using a longitudinal sample of boys ( $N = 503$ ) repeatedly assessed eight times across 6-month intervals in childhood (in a range between 6 and 13 years), the current study is the first to use novel within-individual change (fixed effects) models to examine whether parents tend to increase their use of maladaptive parenting strategies following an increase in their son’s externalizing problems, or vice versa. These bidirectional associations were examined using multiple facets of externalizing problems (i.e., interpersonal callousness, conduct and oppositional defiant problems, hyperactivity/impulsivity) and parenting behaviors (i.e., physical punishment, involvement, parent–child communication). Analyses failed to support the notion that when boys increase their typical level of problem behaviors, their parents show an increase in their typical level of maladaptive parenting across the subsequent 6 month period, and vice versa. Instead, across 6-month intervals, within parent-son dyads, changes in maladaptive parenting and child externalizing problems waxed and waned in concert. Fixed effects models to address the topic of bidirectional relations between parent and child behavior are severely underrepresented. We recommend that other researchers who have found significant bidirectional parent–child associations using rank-order change models reexamine their data to determine whether these findings hold when examining changes within parent–child dyads.

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Compliance with Ethical Standards

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**Conflict of Interest** The authors declare that they have no conflict of interest.

## Keywords

Bidirectional relations; Parenting; Child problem behavior; Fixed effects analysis; Within-individual change

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The impact of parenting behavior on offspring problem behavior has been investigated extensively over the last several decades (Hoeve et al. 2009; Loeber and Stouthamer-Loeber 1986; Scott 2012). Yet investigations have increasingly focused attention on how offspring problem behavior might influence parenting practices over time, as well, by focusing on bidirectional parent–child exchanges (Pardini 2008; Pettit and Loulis 1997). These studies have found that children who exhibit higher problem behaviors tend to have parents who exhibit higher levels of maladaptive parenting over time, and vice versa (Pardini 2008; Pettit and Arsiwalla 2008; Stepp et al. 2014; Waller et al. 2014). Yet such investigations have focused on rank-order changes in child behavior and parenting practices, making it impossible to rule-out between-individual factors (e.g., genetics, family adversity) as potential confounds (Pardini 2008; Pettit and Loulis 1997). In the current study we provide a more stringent test of the mechanisms outlined in bidirectional coercive interchange models by focusing on behavior change within parent–child dyads across multiple longitudinal assessments, using fixed effects models, thereby explicitly controlling for all between-individual factors as potential confounds.

## Coercive Cycle of Parent–Child Interactions

In the late 1960s, seminal work by Bell (1968, 1977) challenged the widespread conceptualization of children as passive recipients of parental socialization techniques. Specifically, Bell's *control systems theory* (1968, 1977) proposed that both parent and child are responsive to the other's behavior and show a pattern of constant reciprocal adaptation. Developmental models subsequently began to outline a more active role of children in shaping their parents' behavior (Mischel 1973; Sameroff 1975). One of the most well-known is Patterson's coercion model (Patterson 1982; Patterson et al. 1984), which proposes that children with a difficult temperament characterized by emotional and behavioral dysregulation tend to elicit maladaptive parenting from their caregivers over time (e.g., harsh discipline). These parenting techniques are postulated to escalate rather than control children's externalizing behavior, leading parents to increasingly withdraw from the relationship in order to escape their child's negative behaviors. Over time, elaborations of Patterson's model have been developed, but the model continues to emphasize this coercive cycle of bidirectional negative reinforcement between children and parents over longer periods of time (Eddy et al. 2001; Patterson 1995; Patterson and Yoerger 2002; Snyder and Stoolmiller 2002).

Patterson's model clearly outlines a cycle of behavior change that occurs within a parent–child dyad. Although it is expected that children with innate predispositions to exhibit problem behavior will have parents who exhibit more maladaptive parenting, it is postulated that an increase in children's problem behavior should be followed by an increase in maladaptive parenting over time, and vice versa. This coercive cycle is posited to be particularly relevant for understanding the development of externalizing problems such as

hyperactivity/impulsivity, interpersonal callousness (e.g., manipulativeness, lacking guilt), and conduct problems (e.g., oppositional, aggressive).

## **Alternative Explanations of Linkages Between Parenting and Child Externalizing Behavior Problems**

A pattern of dynamic and reciprocal interactions that occurs within parent–child dyads is only one possible explanation for why maladaptive parenting has been consistently linked to children’s problem behavior. Several alternative models have placed a greater emphasis on time-stable factors that vary between families as explanatory factors. For example, maladaptive parenting is influenced in part by genetic factors, and this genetic vulnerability can be inherited by children and behaviorally manifested as early problem behavior (Lytton 1990; Maccoby 2000; Oliver et al. 2014; Rutter 1985), exemplifying gene-environment correlation. Also, it is possible that maladaptive parenting strategies remain relatively stable, but might increase children’s problem behaviors over time. Or, the children could have shown maladaptive behavior from an early age at a stable level, but the parents start to adopt worse parenting behaviors over time – perhaps because they feel desperate and therefore adapt to worse parenting strategies. In addition, relatively time-stable factors in the environment (e.g., family poverty) may influence both poor parenting and childhood externalizing behavior and account for their co-occurrence. A key feature of each of these explanations is the focus on factors that vary between parents and/or children as explanatory factors.

The theoretical models outlined above are not mutually exclusive. However, importantly, no previous study in this area has used analytic methods that explicitly focus on covarying behaviors that occur within parent–child dyads, which is necessary to rule out differences between families as potential explanatory factors (see also Larzelere and Cox 2013). Most existing longitudinal studies have used various auto-regressive models (e.g., population average generalized estimating equations (GEE), auto-regressive cross-lagged models) – that primarily examine rank-order changes between parenting and child externalizing behaviors over time. The problem is the assumption that all relevant between-individual confounds have been adequately measured and included in these models, which is a tenuous presumption at best. More importantly, these models do not explicitly examine within-individual changes in parent–child dyads, which is essential to testing the basic tenets of coercive exchange models. In sum, these models do not stringently test whether – over time – parents tend to engage in increasingly maladaptive parenting strategies in response to escalating externalizing behaviors in their children, or vice versa.

### **The Fixed Effects Model**

The fixed effects regression model does explicitly focus on analyzing within-individual change. In the fixed effects model each person acts as his/her own control. The model is very robust and because it only looks at change within an individual, all time stable differences between individuals are factored out of the model. Thereby the model controls for covariates that have not or cannot be measured. In contrast, GEE models take into account the clustered nature of the data with multiple assessments, but treat this as a nuisance and do not model

the (unobserved) heterogeneity between clusters. GEE does not give any information about conditional (individual) effects. GEE is susceptible to cluster-level confounding; in our case for example impulsiveness in both parents and children which might lead to an increase in physical punishment when boys show more hyperactivity. As such, there is a risk of the ecological fallacy, where between individual effects are being interpreted as within-individual effects; inferences are drawn at an individual level based on group level data.

We can also illustrate the difference between these analytical approaches by comparing the formulas of the GEE and the fixed effects model. Consider a situation in which interest centers on the relationship between a predictor variable  $X$  and outcome  $Y$ , which are both observed at repeated time periods. Let  $X_{ij}$  denote the score of the  $j$ th subject at time  $i$  and  $Y_{i+1,j}$  the corresponding score on  $Y$  for the  $j$ th subject at time  $i+1$ . We use the outcome at time  $i+1$  with a predictor at time  $i$ , so we are sure that our outcome variable was measured after the predictor variable. The GEE model linking  $Y_{i+1,j}$  and  $X_{ij}$  is given by

$$Y_{i+1,j} = \beta_1 + \beta_2 X_{ij} + \beta_3 Y_{ij} + \xi_{ij} \quad (1)$$

The outcome  $Y_{i+1,j}$  at time  $t(i+1)$  for a particular individual ( $j$ ) is modeled as a function of a population-average intercept ( $\beta_1$ ) and the individual's predictor  $X_{ij}$ . The outcome behavior  $Y_{ij}$  at time  $t(i)$  is added to the model so we focus on the change in  $Y$  at time  $t+1$  compared to time  $t$ .  $\xi_{ij}$  represents the total residual term with a mean of 0 given the covariates.

The fixed effects model linking  $Y_{i+1,j}$  and  $X_{ij}$  is given by

$$Y_{i+1,j} = \alpha_j + \beta_2 X_{ij} + \epsilon_{ij} \quad (2)$$

The outcome  $Y_{i+1,j}$  at a given occasion  $t(i+1)$  for a particular individual ( $j$ ) is modeled as a function of a person-specific intercept ( $\alpha_j$ ) (instead of a population-average intercept in GEE) and the predictor  $X$  (with coefficient  $\beta_2$ ).  $\epsilon_{ij}$  represents the occasion and person-specific error term with mean 0 and variance  $\theta$ .

In the GEE model, the regression coefficient  $\exp(\beta_2)$  represents the estimated average increase in  $Y$  at the next assessment per unit increase in  $X$ , taking into account the current level of  $Y$ . In the fixed effects model, the regression coefficient  $\exp(\beta_2)$  represents the estimated average increase in  $Y$  at the next assessment per unit increase in  $X$ , only looking at within-individual differences, controlling for stable difference between individuals.

To summarize, the fixed effects model tests whether children who increase certain problem behaviors at any given wave have parents who increase certain maladaptive parenting relative to their typical, that is, mean levels of those behaviors in the next wave (and vice versa). Other studies in this area have focused on regression-based models that do not differentiate between-individual change (i.e., change in the relative rank of individuals in terms of a trait of interest) from within-individual change (i.e., change in one's own propensity). As a result, these previous studies cannot rule out the possibility that time-invariant between-subject factors may be driving the association between parent and child

behavior over time. Our analytic design, using fixed effect models, ensures that all stable between-subject factors are ruled out as potential confounds: fixed effects models only index how a child's behavior changes as a result of their own parent's behavior (and vice versa). Curran and Bauer (2011) give an excellent and clear example explaining how these two models investigate two different questions:

An example from the medical literature nicely illustrates the need to disaggregate levels of effect. Empirical evidence has shown that an individual is more likely to experience a heart attack while exercising (i.e., the within-person effect), but at the same time people who exercise more tend to have a lower risk of heart attack (i.e., the between-person effect) [...]. Both the within-person and between-person findings are valid, and each has direct public health relevance. However, generalizing the between-person effect to the individual would be an error of inference (e.g., the more you exercise the more likely you are to suffer a heart attack). Further, examining only one level of this more complex two-level effect would necessarily limit the development of complete understanding of the true nature of these relations (p. 586).

Although other investigators have addressed the topic of bidirectional relations between parent and child behavior, the use of within-individual change models to more stringently test for associations is severely underrepresented in this field of research: Focusing solely on within-individual change is an underutilized method for improving causal inference. This approach is increasingly being recognized by many in the field as crucial (Allison 2009; Curran and Bauer 2011; Osgood 2010; Osgood et al. 1996). It is essential to also investigate the question of within-individual changes and this paper fills this gap in the current literature (Farrington 2015).

## Current Study

The goal of the current study is twofold: (1) to improve causal inference (though not prove it) by eliminating between-individual confounds using within-individual change (fixed effects) models, and (2) to test for bidirectional effects in a manner consistent with existing theoretical models, which assert that when a child increases his level of behavior problems, a parent tends to respond by increasing maladaptive parenting over time, and vice versa (e.g., intra-individual change).

Our aim is to stringently test the tenets of the bidirectional influence models by examining changes in both parenting practices and son behavior within parent-son dyads, thereby controlling for time-stable and pre-existing differences between families as potential confounds. We do so by using a longitudinal sample of 1<sup>st</sup> grade boys and their families, who were assessed every 6 months over the course of 4 years. We examine whether changes in various facets of externalizing problems (i.e., hyperactivity/impulsivity, interpersonal callousness, conduct problems) are associated with subsequent changes in different maladaptive parenting behaviors that have been outlined in coercive interchange models (i.e., physical punishment, low involvement, poor communication), and vice versa. Patterson's model includes interchanges between parents and children that can be investigated on two distinct levels: a) the micro-level where a child's negative behavior

would immediately be followed by a parent's negative behavior; and b) the longer-term level where parent and child behavior covary. Patterson discusses both levels and emphasizes that these behavior cycles form *over time*. The coercive cycle does not happen within a day, but involves a longer term pattern of covarying parent and child behavior. In this paper, we focus on examining these longer-term patterns of parent and child behavior. Our research question is whether there is a bidirectional association between changes in sons' externalizing problems and changes in maladaptive parenting within parent-son dyads.

## Method

### Participants

The current investigation used data from the youngest cohort of the Pittsburgh Youth Study (PYS), a prospective longitudinal study of boys who were initially recruited from the Pittsburgh Public Schools in 1987–1988. The youngest cohort was selected from a larger pool of 1,165 children registered to attend the 1<sup>st</sup> grade. Of these boys, 849 were selected to undergo a multi-informant (i.e., parent, teacher, child report) screening that assessed early conduct problems (e.g., fighting, stealing). Boys identified at the top 30 % on the screening risk measure ( $N=256$ ), and a roughly equal number of boys randomly selected from the remainder ( $N=247$ ), were selected for longitudinal follow-up (total  $N=503$ ). The follow-up sample was not significantly different from the screening sample in terms of race, family composition, and California Achievement Test reading scores. The boys' mean age at screening was 6.9, and racial composition was predominately White (40.6 %) and African-American (55.7 %). Nearly all primary caregivers were biological mothers (92 %), with 45.3 % cohabiting with a partner and 16.9 % completing fewer than 12 years of schooling. Over half of families (61.3 %) were receiving public financial assistance (e.g., food stamps). Greater detail on participant selection and sample characteristics is available elsewhere (see Loeber et al. 1998).

### Procedures

Following screening, families in the PYS were initially interviewed every 6 months for eight consecutive assessments, with annual assessments being conducted thereafter for 9 years. Because of our interest in examining changes that may occur over relatively brief periods of time in childhood, we used only the 6-month assessments herein. During each of the assessments, both the boy and his primary adult caretaker (to whom we will refer as "parent" in this paper) were interviewed separately, and the boy's teacher completed self-administered questionnaires. Informed written consent was obtained from both the boys and their parents. The data collection procedures were approved by the Institutional Review Board at the University of Pittsburgh (for further details see Loeber et al. 1998).

Among the 503 boys initially selected, one boy was never assessed afterwards, nine boys were assessed only once, and another six boys were assessed only twice. These 16 boys could not be included in our fixed-effects model.



## Parenting Variables

Parenting behaviors were measured using parent-report questionnaires. Some items were more indicative of the child's behavior rather than the parent (e.g., "Does your son leave you a note or call you to let you know where he is going?") and such items were eliminated from the scales below as outlined in Pardini et al. (2008). Parenting scales were scored on a 3-point Likert metric (1 = *almost never*, 2 = *sometimes*, 3 = *almost always* or *often*, depending on the scale). When a scale contained more than one item, we used the average score and reverse-scored relevant items so that higher ratings indicated increased levels of maladaptive parenting. Extensive details regarding the psychometric properties, temporal stability, and predictive utility of each of these parenting scales were reported elsewhere (Burke et al. 2008; Loeber et al. 2000; Pardini et al. 2008).

**Physical punishment**—Physical punishment was measured using one item from Loeber et al.'s (1998) Discipline Scale: "If your son does something that he is not allowed to do or that you don't like, do you slap or spank him, or hit him with something?" We dichotomized this item, because the number of parents responding "often" using physical punishment was extremely low across phases (<5 %). Although relying on a single item to assess a construct is not ideal, previous studies have found that this single item robustly predicts future conduct problems and serious delinquency in youth and shows evidence of moderate temporal stability (Fite et al. 2009; Loeber et al. 2008; Pardini et al. 2008).

**Low parental involvement**—Low parental involvement was measured using the Supervision/Involvement scale (Loeber et al. 1998) and defined as how often parents engaged in joint activities with their son. Six items were used (e.g., "Do you and your son do things together at home?"). The average internal consistency was moderate across all assessments (mean  $\alpha = .72$ ).

**Poor parent-child communication**—Poor parent-child communication was assessed using the Revised Parent-Adolescent Communication Form (Loeber et al. 1998), which asks parents how often they discuss issues with their child in an open and supportive manner while gradually fostering the child's psychological autonomy (e.g., "Do you encourage your son to think about things himself and talk about them so that he can establish his own opinion?"). This scale consists of 34 items and displayed moderate levels of internal consistency across the assessments used (mean  $\alpha = .80$ ).

## Son's Externalizing Behavior Problems

Child externalizing behavior was assessed using the Child Behavior Checklist (Achenbach 1991) and the Teacher Report Form (Achenbach and Edelbrock 1986). Parents and teachers were asked to rate how well each item described the boy in the past 6 months on a 3-point Likert scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*). We used a combination of both parent and teacher assessments to avoid the shared method inherent in using identical informants (parents) to index parenting practices and child externalizing behaviors. For each item, the higher of the two ratings was used and then all items were averaged so that higher levels indicated more problem behavior.<sup>1</sup> We have chosen to use a combined parent-teacher report, because such a composite is apt to be more



reliable than either informant alone. It also takes into account the finding that children may exhibit different behavior problems in different settings (Achenbach et al. 1987).

Three scales were created that indexed distinct, yet overlapping, facets of behavioral problems: hyperactivity/impulsivity, interpersonal callousness, and conduct problems. Prior studies have shown that these constructs are partially independent from childhood through adolescence and are associated with the development of severe antisocial behavior (Byrd et al. 2012; Hinshaw 1987; Pardini and Loeber 2008; Pardini et al. 2006). The correlations between parent and teacher report for each of these three scales was  $r = .30$  ( $df = 3490$ ) for hyperactivity/impulsivity;  $r = .28$  ( $df = 3484$ ) for interpersonal callousness;  $r = .30$  ( $df = 3465$ ) for conduct problems. These correlations correspond to research from the past decades showing that the magnitude of parent and teacher agreement has been low to moderate (e.g., Achenbach et al. 1987; Cai et al. 2004; Rescorla et al. 2014; Spiker et al. 1992; Stanger and Lewis 2010).

**Interpersonal callousness**—Interpersonal callousness is defined as being deceitful, manipulative, selfish, superficially charming, and lacking empathy (Pardini et al. 2006). Items relating to interpersonal callousness were “denies wrongdoing,” “you can’t trust what he says,” and “acts sneakily,” “doesn’t seem to feel guilty after misbehaving,” “does not keep promises,” “exaggerates,” “manipulates people,” “fast or smooth talker”. The variable interpersonal callousness is an average of these eight items and the average internal consistency across assessments was moderately high ( $\alpha = .89$ ).

**Conduct problems or oppositional defiant problems**—Conduct problems or oppositional defiant problems included features of conduct disorder and oppositional/defiant behaviors. Items relating to *conduct problems or oppositional defiant problems* were “hits or physical fights,” “cruelty, bullying, meanness to others,” “threatens people,” “steals,” “argues a lot,” “defiant, talks back to staff,” “temper tantrums or hot temper,” “disobedient at school,”/“disobedient at home,” “stubborn, sullen or irritable,” “gets into many fights,” “physically attacks people,” “starts a physical fight over nothing,” and “destroys property belonging to others”. The variable CD/ODD is an average of 13 items and the average internal consistency across assessments was moderately high ( $\alpha = .91$ ).

Items relating to *hyperactivity* were “Impulsive or acts without thinking,” “Fidgets,” “Talks out of turn,” “Cannot sit still, restless, or hyperactive,” “Unusually loud,” and “Talks too much.” The variable hyperactivity is an average of these six items and the average internal consistency across assessments was moderately high ( $\alpha = .86$ ).

### Potential Confounding Variables

Several time-varying variables that change within parent–child dyads were included as potential confounds, given they have been associated with both maladaptive parenting as well as childhood conduct problems. Specifically, information on parents’ educational attainment and current occupation were used to calculate the Hollingshead Index of Socio-

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<sup>1</sup>Note that we also conducted these analyses with son’s behavior measured by teachers only and parents only and found similar results to those presented below. These supplemental analyses are available upon request from the primary author.

Economic Status (SES) (Hollingshead 1975). Additional covariates included the boys' age, number of weeks the caretaker was unemployed in the past 6 months, the presence of a romantic partner in the home, and the number of children in the home.

Table 1 reports means and standard deviations for the study variables. Three standard deviations show how much these variables varied between and within individuals: the total standard deviation, the between-individual standard deviation, and the within-individual standard deviation. It is standard for researchers using multilevel analyses to report the variation between and within individuals; this is particularly crucial in fixed-effect analyses, to ensure that there is enough variation within individuals. Physical punishment varied roughly the same between and within individuals. Although the other variables varied more between than within individuals, there was still substantive variability in the study variables within individuals over time.

Figure 1 shows the development of both sons' and parenting behaviors over time. The behaviors were relatively stable over time, although physical punishment and hyperactivity/impulsivity decreased slightly, whereas conduct problems and interpersonal callousness increased modestly over time.

### Data Analysis

All analyses were conducted using fixed-effects regression models within Stata 12 (StataCorp 2011). The strength of such models is that they focus solely on whether within-individual change in a predictor is associated with within-individual change in a dependent variable across the entire time series. In essence, time-varying deviations from an individual's typical level on an outcome (i.e., their mean level across the entire time series) are modeled as a function of time-varying deviations from their typical level on predictors. Using this person-mean-centering approach to assess change within individuals allows each person to act as his/her own control, which strengthens causal inference by eliminating all time-stable factors that vary between individuals (e.g., genetics, parental history of antisocial behavior) as potential confounds. For more information on fixed-effect models see e.g., Allison (2009); Bushway et al. (1999); and Rabe-Hesketh and Skrondal (2012).

Because our purpose was to examine whether changes in a son's externalizing behavior predicted subsequent changes in parenting (and vice versa), all dependent variables examined were lagged forward by one assessment wave ( $t + 1$ ). The equation below illustrates a model specifying the unique association between within-individual change in each facet of externalizing behavior and change in parental involvement at the subsequent assessment across the entire time series, after controlling for time-varying confounds. Identical models were conducted for each facet of parenting, except a logistic fixed-effects regression model was used for the single-item, dichotomously scored indicator of physical punishment.

$$\begin{aligned}
 \text{LowInvolvement}_{i+1,j} = & \alpha_j + \beta_2 \text{Callousness}_{ij} \\
 & + \beta_3 \text{CDODD}_{ij} + \beta_4 \text{Hyperactivity}_{ij} \\
 & + \beta_5 \text{Ageboy}_{ij} + \beta_6 \text{SES}_{ij} + \beta_7 \text{Partner}_{ij} \\
 & + \beta_8 \text{Unemployed}_{ij} \\
 & + \beta_9 \text{Children}_{ij} + \epsilon_{ij}
 \end{aligned} \tag{3}$$

Low parental involvement at a given occasion  $t(i + 1)$  for a particular parent ( $j$ ) was modeled as a function of a person-specific intercept ( $\alpha_j$ ); the son's interpersonal callousness (with coefficient  $\beta_2$ ), conduct problems ( $\beta_3$ ), and hyperactivity ( $\beta_4$ ); son's age at assessment ( $\beta_5$ ); parental Socio-Economic Status ( $\beta_6$ ); whether a partner was living in the home ( $\beta_7$ ); the number of weeks the parent had been unemployed in the past 6 months ( $\beta_8$ ); and the number of children in the home ( $\beta_9$ ).  $\epsilon_{ij}$  represents the occasion and person-specific error term with mean 0 and variance  $\theta$ .

Models predicting changes in each of the externalizing outcomes from changes in parenting were similarly specified, with the equation below illustrating the model predicting changes in the boy's interpersonal callousness:

$$\begin{aligned}
 \text{Callousness}_{i+1,j} = & \alpha_j + \beta_2 \text{PhysicalPunishment}_{ij} \\
 & + \beta_3 \text{LowInvolvement}_{ij} \\
 & + \beta_4 \text{PoorCommunication}_{ij} \\
 & + \beta_5 \text{Ageboy}_{ij} + \beta_6 \text{SES}_{ij} + \beta_7 \text{Partner}_{ij} \\
 & + \beta_8 \text{Unemployed}_{ij} \\
 & + \beta_9 \text{Children}_{ij} + \epsilon_{ij}
 \end{aligned} \tag{4}$$

## Results

Table 2 presents estimates for the fixed effects (FE) models examining whether changes in sons' externalizing behavior influenced subsequent changes in parenting behavior. Son's age predicted physical punishment: for each year that the boy got older, the odds that his parents would use physical punishment decreased by 35%. SES was positively related to poor communication: during periods when parents experienced an increase in their SES, they were more likely to show poorer communication with their sons. Overall, we found no evidence that changes in the boys' externalizing behaviors were significantly associated with changes in parenting 6 months later.

Table 3 presents the estimates for the FE models examining whether changes in specific parenting behaviors influenced subsequent changes in the boys' externalizing behavior within parent-child dyads. In these models interpersonal callousness increased with son's age but hyperactivity/impulsivity decreased with son's age, which corresponds with our descriptive results describing the development of these behaviors over time. However, in no instance did parenting behaviors predict sons' behaviors 6 months later.

Because changes in behavior could happen over a shorter time interval than currently assessed (e.g., every 6 months), we conducted supplementary fixed-effects analyses examining contemporaneous changes in parenting and child behavior. The results for these analyses can be found in the supplementary Tables A1 through A5. In a model including all facets of externalizing behaviors (Table A1), increased levels of hyperactivity/impulsivity at a given time point were associated with more parental involvement. When we examined models including each of the son behaviors separately, we saw several significant relations. Table A2 shows that interpersonal callousness predicted more physical punishment and more poor communication. Table A3 shows the same pattern for conduct problems, which predicted more physical punishment and poor communication. Hyperactivity/impulsivity was less strongly related to parenting behaviors.

Looking at the other direction, parenting behaviors, and in particular physical punishment and to a lesser extent poor parental communication contemporaneously predicted interpersonal callousness and conduct problems (Table A5).

## Discussion

To our knowledge, this is the first longitudinal study to examine bidirectional associations between changes in sons' externalizing behavior (hyperactivity/impulsivity, conduct problems, and interpersonal callousness) and maladaptive parenting (physical punishment, low parental involvement, poor parent-child communication) within parent-child dyads across 6-month assessments spanning 4 years using fixed effects models. The results of our predictive models did not support one of the basic tenets of the coercive interaction model, which suggests that as children escalate their typical level of problem behavior, parents respond by subsequently increasing their maladaptive parenting strategies over time, and vice versa. Although supplementary analyses indicated that there is a waxing and waning of concurrent changes in maladaptive parenting and sons' externalizing behaviors within parent-child dyads over time, the underlying temporal ordering (and therefore the potential causal direction) of this association remains unclear.

In a previous study using the PYS, Pardini et al. (2008) demonstrated that sons' externalizing behaviors predicted subsequent rank-order changes in maladaptive parenting behavior (and vice versa) across the developmental period examined in the current study.<sup>2</sup> However, this previous study did not model change in the predictor variables and examined only rank-order changes in the dependent variable. As a result, this prior study using the PYS, as well as many others using similar techniques, were unable to draw conclusions about changes that occur within parent-child dyads (Larzelere and Cox 2013). Importantly, investigations focused on rank-order change provide no definitive information about changes that occur within parent-child dyads. As we discussed in the introduction and illustrated with the medical example by Curran and Bauer (2011), it is essential to investigate the between- as well as within-individual relationships. Our within-individual examination of the coercive interchange model found no evidence that sons who increased their

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<sup>2</sup>We also conducted GEE analyses using the same variables as in our Fixed Effect analyses and found similar results (see the Supplementary Tables A6 to A10).

externalizing problems had parents who increased their use of maladaptive parenting over the subsequent 6 months period, or vice versa. This “null” finding suggests that bidirectional predictive associations between parenting and child externalizing behavior may be largely explained by factors that differ between parent–child dyads, particularly when examining changes in behavior that occur 6 months apart.

An interesting finding is that during periods when parents experienced an increase in their SES, they tended to show poorer communication with their sons. In periods when they experienced a decrease in their SES, they showed better communication with their sons. This is different from results from studies on between-individual differences: most prior studies focusing on between-individual differences find that families of lower socio-economic backgrounds tend to have parents with less adaptive parenting skills (Bornstein and Bradley 2012; Kaiser and Delaney 1996).

In terms of clinical and practical implications, it may well be the case, particularly given the contemporaneous predictions of parenting from child behaviors and vice versa, that interventions directed at both reducing externalizing problems in youth and at enhancing more authoritative (warmth plus firm control) parenting styles are needed to address escalating patterns of antisocial behavior in at-risk children. Our data on non-significant within-family 6-month predictions from child behavior to parenting behavior, and vice versa, do not allow the implication that either changes in parenting behavior or child behavior are “primary.” Rather, to address the patterns of negative interchange, among boys with externalizing tendencies and their families, that predict escalation of antisocial behavior, multimodal treatments supporting child cognitive-behavioral-affective change *and* more productive disciplinary practices are indicated (see McMahon et al. 2006).

## Limitations

The present findings underscore an important consideration regarding the use of longitudinal data to examine bidirectional parent–child effects. As we discussed in the introduction, one can investigate a coercive cycle of behavior on two levels: a) the micro-level where a child’s negative behavior would immediately be followed by a parent’s negative behavior; and b) the longer-term level where parent and child behavior covary over time. Although the PYS used 6-month assessments, which may be the shortest interval for longitudinal assessments in a large longitudinal sample, we were only able to investigate the longer-term level and we cannot investigate the moment-to-moment interactions with our data. Even though we did not find support for the longer-term processes, it is still possible that an escalating cycle of coercive exchanges within parent–child dyads occurs over shorter time intervals. If a boy increases certain problem behaviors, parents might not necessarily wait 6 months to change their parenting behavior. It is possible that such processes happen within a time frame of a couple of weeks (Bell 1971; Bell and Chapman 1986; Coley and Medeiros 2007). As noted by the supplemental analyses, changes in parenting and son externalizing behavior co-occurred simultaneously within parent–child dyads, but we cannot conclude anything about causality based on these findings. To draw conclusions about cause and effect, a predictor must precede the outcome in time (Kraemer et al. 2005). Without this temporal precedence,

it is impossible to know whether son behavior impacts parenting or vice versa or whether they covary over time because of some other time-varying factors.

Another limitation was that the analyses examined changes that occurred only from ages 6 to 13 years of age. It is possible that more dynamic influences happen at a younger age. One could hypothesize that behavior interactions such as described by Patterson (1982) happen when children are younger and that these interactions stabilize before the age of 6, which may explain why a dynamic relation was not found in the current study. It is possible that maladaptive parenting strategies remain relatively stable, but might increase children's problem behaviors over time. Or, the children could have shown maladaptive behavior from an early age at a stable level, but the parents start to adopt worse parenting behaviors over time. By focusing on within-individual change in both the predictor and the outcome, these types of associations cannot be detected.

Another potential limitation is that physical punishment was measured using one item from Loeber et al.'s (1998) Discipline Scale. However, although relying on a single item to assess a construct is not ideal, previous studies have found that this single item robustly predicts future conduct problems and serious delinquency in youth and shows evidence of moderated temporal stability (Fite et al. 2009; Loeber et al. 2008; Pardini et al. 2008).

Finally, this study included only boys, and the conclusions cannot be easily generalized to girls. In general, boys exhibit more externalizing problem behaviour such as delinquency, while girls have more internalizing problems such as anxiety and depression (Capaldi et al. 2002; Robins 1966, 1986). Although it remains outside the scope of this article to fully discuss differences between boys and girls, one could expect certain child behaviors to elicit certain parent behaviors and vice versa (see e.g., Burke et al. 2008).

### Future Directions

These considerations lead to interesting possibilities for future research. Even though the PYS used 6-month assessments, one could argue that this could be a limitation when investigating interactions that can change over a short time period, especially if one is interested in moment-to-moment interactions that might happen on a more micro-level time scale. Thus, it is vital to design longitudinal studies to collect data on parent-child interactions for shorter time intervals, potentially through the use of ecological momentary assessments. A more informative design may be to collect measurements of each behavior sampled a few times a week over the course of several months. In other words, most studies so far have focused on longer term processes, but it would be interesting to also study the bidirectional interactions between parents and children on a more micro-level timescale. Likewise, future studies should investigate these relations for younger children, as behavior interaction patterns might be more dynamic at a younger age. It will also be important to investigate whether the results reported here are generalizable to girls and their parents.

Although other investigators have addressed the topic of bidirectional relations between parent and child behavior, the use of within-individual change fixed effects models to more stringently test for associations is severely underrepresented in this field of research (Allison 2009; Curran and Bauer 2011; Osgood et al. 1996; Osgood 2010). This is a surprising

omission, given that analyses focused on examining change within parent–child dyads are arguably the best method for testing the basic tenets of coercive interchange models. However, a challenge in using these models is that they tend to produce large standard errors (compared to random-effects models), because they examine only intra-individual change (Allison 2009). It is thus harder to find statistically significant results, which might explain the lack of published papers focused on examining within-individual change (Wilson 2009). However, it is essential to publish non-significant results like the ones reported, especially because they provide a more stringent test of the associations posited in coercive interchange models than previous studies (Cumming 2014; Ioannidis 2005). For this reason, we would recommend that other researchers who have found significant bidirectional parent–child associations using rank-order change models reexamine their data to determine whether these findings hold when examining changes within parent–child dyads.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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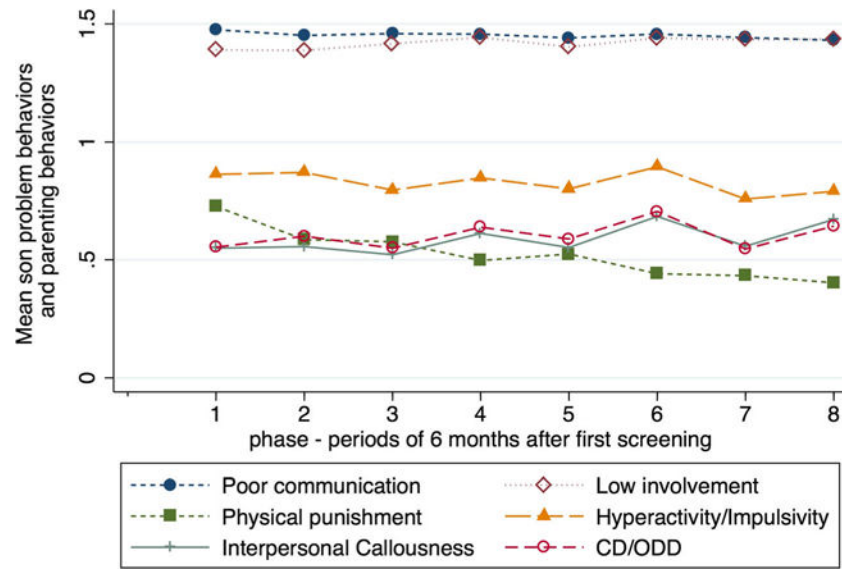
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**Fig. 1.**  
The development of sons' and parenting behaviors is relatively stable over time

**Table 1**  
Mean, standard deviation of within and between level and minimum and maximum for all variables

Variable	Mean	Std. Dev.	Min	Max
Interpersonal callousness	Overall	0.51	0	2
	Between	0.39		
	Within	0.33		
Conduct problems	Overall	0.48	0	2
	Between	0.39		
	Within	0.29		
Hyperactivity/impulsivity	Overall	0.56	0	2
	Between	0.44		
	Within	0.34		
Physical punishment	Overall	0.450	0	1
	Between	0.34		
	Within	0.37		
Low involvement	Overall	1.42	1	3
	Between	0.25		
	within	0.20		
Poor communication	Overall	1.452	1	2.35
	Between	0.25		
	Within	0.16		
Socio-economic status	Overall	12.29	6	66
	Between	10.49		
	Within	6.33		
Partner in the home	Overall	0.54	0	1
	Between	0.43		
	Within	0.26		
N of weeks parent unemployed	Overall	10.05	0	26
	Between	9.34		
	Within	7.64		
Number of kids in the home	Overall	1.66	0	10

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Variable	Mean	Std. Dev.	Min	Max
Between		1.12		
Within		0.54		

**Table 2**  
 Cross-lagged Fixed effects regression of boy's problem behavior predicting parent's maladaptive parenting (t + 1) (analyses showing children's behavior measured by parents as well as teachers)

	Physical punishment			Low involvement			Poor communication		
	OR	95 % CI	B	95 % CI	B	95 % CI	B	95 % CI	
Interpersonal callousness	1.05	0.65	1.70	0.0104	-0.0324	0.0532	-0.0006	-0.0332	0.0321
CD/ODD	1.15	0.66	2.01	-0.0040	-0.0491	0.0410	0.0037	-0.0326	0.0400
Hyperactivity/impulsivity	0.96	0.64	1.46	-0.0051	-0.0387	0.0286	-0.0034	-0.0304	0.0236
Boy age	0.65	0.57	0.73	0.0047	-0.0054	0.0149	-0.0045	-0.0127	0.0038
SES	1.00	0.98	1.02	0.0012	-0.0004	0.0029	0.0011	0.0001	0.0023
Partner in home	0.84	0.54	1.29	-0.0061	-0.0440	0.0318	-0.0143	-0.0456	0.0170
Weeks unemployed	1.00	0.99	1.02	0.0009	-0.0003	0.0021	0.0008	-0.0001	0.0016
Kids in home	1.00	0.82	1.22	0.0111	-0.0055	0.0278	-0.0059	-0.0268	0.0151
Number of observations	1590			2622			2622		
Number of subjects	280			489			489		

CD/ODD = Conduct problems or oppositional defiant problems



Table 3  
 Cross-lagged Fixed effects regression parent's maladaptive parenting predicting boy's problem behavior (t + 1) (analyses showing children's behavior measured by parents as well as teachers)

	Interpersonal callousness			CD/ODD			Hyperactivity/impulsivity		
	B	95 % CI		B	95 % CI		B	95 % CI	
Physical punishment	0.0005	-0.0356	0.0367	0.0236	-0.0079	0.0551	0.0320	-0.0008	0.0649
Low involvement	-0.0542	-0.1246	0.0162	-0.0608	-0.1281	0.0066	-0.0470	-0.1265	0.0324
Poor communication	0.0133	-0.0860	0.1126	0.0478	-0.0427	0.1383	0.0492	-0.0528	0.1513
Boy age	0.0322	0.0151	0.0493	0.0115	-0.0037	0.0267	-0.0291	-0.0466	-0.0116
SES	-0.0004	-0.0032	0.0025	-0.0000	-0.0026	0.0026	0.0010	-0.0017	0.0037
Partner in home	-0.0110	-0.0795	0.0575	0.0045	-0.0543	0.0633	0.0020	-0.0614	0.0655
Weeks unemployed	0.0009	-0.0008	0.0026	0.0013	-0.0001	0.0028	-0.0012	-0.0031	0.0006
Kids in home	-0.0157	-0.0449	0.0135	-0.0099	-0.0359	0.0160	-0.0291	-0.0585	0.0002
Number of observations	2664			2664			2664		
Number of subjects	499			499			499		

The number of subjects for the analyses with physical punishment as outcome is lower than for the other outcomes. Since a fixed effects model only focuses on within-individual change, all subjects who do not vary in terms of the predictor or outcome variable are excluded from the analyses. This effect is stronger when one uses a dichotomous variable such as we did with physical punishment. It is more likely that someone shows variation on a scale from 1 to 3 consisting of several items compared with a dichotomous variable where one can score only 0 or 1. Hence, the number of subjects is much smaller in the fixed effects analysis with physical punishment as outcome variable