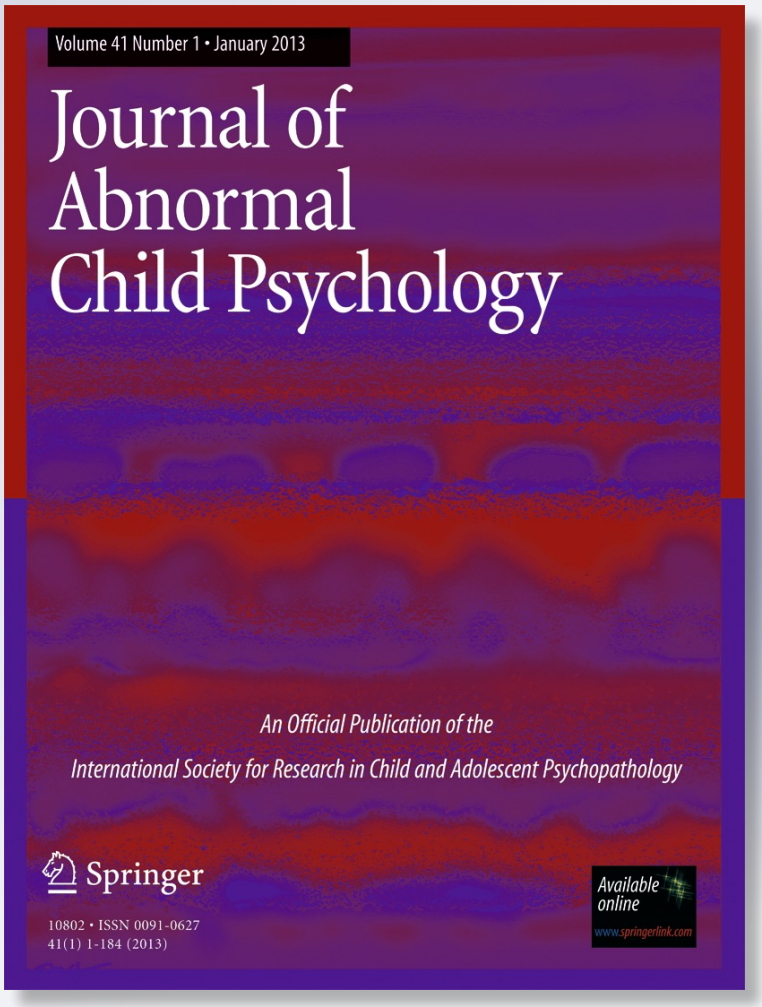
Testing Informant Discrepancies as Predictors of Early Adolescent Psychopathology: Why Difference Scores Cannot Tell You What You Want to Know and How Polynomial Regression May

Robert D. Laird & Andres De Los Reyes

Journal of Abnormal Child Psychology
An official publication of the International Society for Research in Child and Adolescent Psychopathology

ISSN 0091-0627
Volume 41
Number 1

J Abnorm Child Psychol (2013) 41:1-14
DOI 10.1007/s10802-012-9659-y



Springer

J Abnorm Child Psychol (2013) 41:1–14
DOI 10.1007/s10802-012-9659-y

Testing Informant Discrepancies as Predictors of Early Adolescent Psychopathology: Why Difference Scores Cannot Tell You What You Want to Know and How Polynomial Regression May

Robert D. Laird · Andres De Los Reyes

Published online: 8 July 2012

Abstract Multiple informants commonly disagree when reporting child and family behavior. In many studies of informant discrepancies, researchers take the difference between two informants' reports and seek to examine the link between this difference score and external constructs (e.g., child maladjustment). In this paper, we review two reasons why difference scores cannot serve as unambiguous predictors of outcomes. Further, we use polynomial regression analyses to both test the validity of difference scores and provide a more direct test of the hypothesis that discrepancies in parent and child reports predict child psychopathology. Data from 218 parent-adolescent dyads (*M* adolescent age=11.5 years, 51 % female; 49 % European American, 47 % African American) were used to predict adolescent-reported antisocial behavior and depression from parent and adolescent reports of parent-adolescent conflict, parental knowledge, parental acceptance, adolescent rule-breaking behavior, and adolescent pubertal development. Results demonstrate that analyses using difference scores do not provide valid tests of the utility of informant discrepancies in predicting adolescent psychosocial maladjustment. However, interaction terms in polynomial regression analyses provide evidence that informant discrepancies predict child psychopathology. Parent-adolescent informant discrepancies predict adolescent psychopathology but researchers should avoid using difference scores to measure informant discrepancies. Polynomial regression analyses provide more comprehensive and accurate tests of whether informant discrepancies predict child and adolescent psychopathology.

Keywords Multiple informants · Informant discrepancies · Difference score · Antisocial behavior · Depression

This research was supported by grants from the National Science Foundation (BCS 0517980 & 0807650) to R. D. Laird. We thank the teachers and principals from the East Baton Rouge Parish School System and the families who participated in this research. Thanks to Carl F. Weems for comments on early drafts of this paper.

R. D. Laird (✉)
Department of Psychology, University of New Orleans,
New Orleans, LA 70148, USA
e-mail: rlaird@uno.edu

A. De Los Reyes
Department of Psychology,
University of Maryland at College Park,
College Park, MD, USA

When multiple informants such as parents and children provide independent reports on the same construct, the reports are typically only modestly correlated, suggesting substantial discrepancies in perspective among informants (Achenbach et al. 1987; De Los Reyes and Kazdin 2004, 2005). Discrepancies among informants' reports have substantial implications for empirical studies in a variety of areas including studies of risk factors of child and adolescent psychopathology, as well as tests of the efficacy of prevention and intervention programs (De Los Reyes and Kazdin 2005, 2006, 2008, 2009). Essentially, for any one empirical finding based on a single informant's report, the conclusions one draws from that finding are quite likely to conflict with conclusions drawn from findings based on other informants' reports (De Los Reyes 2011). As such, the pervasiveness of informant discrepancies necessitates empirical work focused on understanding the meaning of these discrepancies and identifying optimal approaches for interpreting discrepancies when they arise. Cross-reporter discrepancies have been investigated using difference scores and polynomial regression models (for a review see Laird and Weems 2011). The purpose of the current study is to demonstrate why difference scores are an invalid approach

to studying informant discrepancies. In doing so, we demonstrate how interaction terms in polynomial regression analyses provide more valid tests of the utility of informant discrepancies in developmental psychopathology research.

Studying the Mechanisms Underlying Informant Discrepancies

Informant discrepancies may be explained, in part, by random error variance (e.g., De Los Reyes 2012). However, apart from measurement error, informant discrepancies may also contain meaningful information about the constructs or behaviors assessed (e.g., De Los Reyes 2011; Funder 2009; Tein et al. 1994). To this end, researchers have advanced conceptual frameworks for studying the source and importance of informant discrepancies (for reviews see De Los Reyes and Kazdin 2005, 2006; Goodman et al. 2010; Kraemer et al. 2003; Richters 1992). A brief overview of these frameworks highlights the various approaches to studying informant discrepancies and provides a context for the present study.

One class of conceptual models focuses on contextual variation as the source of informant discrepancies. Recent research and theory indicates that informants vary in terms of their perspectives on the behaviors being assessed (e.g., self- versus other-perspective) and often in the settings in which they observe these behaviors (e.g., home versus school settings; De Los Reyes and Kazdin 2005; De Los Reyes et al. 2009, 2012a, b; Kraemer et al. 2003). A second class of conceptual models (and perhaps the most widely studied) focuses on characteristics of the informants as being responsible for informant discrepancies. For example, the *depression→distortion* hypothesis proposes that informants' levels of depressive mood symptoms underlie why informants provide reports that disagree with each other (e.g., Richters 1992). The third class of conceptual models focuses on informant discrepancies as predictors of external indicators of psychosocial functioning. For example, a number of studies have reported findings interpreted as revealing that informant discrepancies in reports of child characteristics and behavior prospectively predict poor child and family psychosocial outcomes (e.g., risky driving, delinquency, psychopathology). Although a variety of methodological and statistical approaches have been applied to testing the models of informant discrepancies (for a review see De Los Reyes and Kazdin 2005), many researchers have used some variant of difference scores to operationally define "informant discrepancies" (e.g., subtracting a total score from one informant's report from the total score of another informant's report). We focus primarily on the second and third classes of conceptual models, because researchers examining the first class of conceptual models have rarely used difference scores. The key difference between the second and third class of models is that difference scores serve as dependent variables in tests of depression→distortion models whereas difference scores serve as independent variables when testing discrepancies as predictors of psychosocial functioning (De Los Reyes and Kazdin 2004).

Purpose

In this paper, we focus on the use of difference score and polynomial regression approaches to test informant discrepancy hypotheses in developmental psychopathology research. Specifically, we describe two key limitations of difference scores and explain why previous analyses of difference scores do not adequately test whether informant discrepancies (a) predict psychopathology or (b) can be predicted from other psychosocial constructs (e.g., informants' depressive mood symptoms). In highlighting these limitations of difference score approaches to measuring informant discrepancies, we advance a statistical method (i.e., polynomial regression analyses) that has been used to assess multi-informant reporting discrepancy in other fields (personnel or workplace assessment in industrial/organizational psychology research; Edwards 1994). We argue and demonstrate how this method can be used to both evaluate the validity of analyses using difference scores and provide a more direct test of informant discrepancy hypotheses. Lastly, we provide recommendations for researchers seeking to advance the study of informant discrepancies in developmental psychopathology research.

Limitations of Difference Scores

Although it may seem that the most direct way to study informant discrepancies is to simply subtract the score provided by one informant from the score provided by the other informant, doing so introduces a number of interpretive challenges. The interpretative challenges apply to directional difference scores (i.e., subtracting one informant's score from another), which purportedly test whether one informant reports greater levels of a measured behavior, relative to another informant's report of that same behavior (i.e., informant superiority). Similarly, these challenges are inherent in using squared (i.e., squaring a directional difference score) or absolute (i.e., taking the absolute value of a directional difference score) difference scores, which purportedly test the degree of congruency or discrepancy rather than informant superiority. A number of these interpretive challenges (e.g., psychometric properties of difference scores) have been reviewed and critiqued extensively (e.g., De Los

Reyes et al. 2011; Edwards 1994, 2002; Griffin et al. 1999; Johns 1981; Laird and Weems 2011; Rogosa and Willett 1983). Our discussion focuses on the two problems that challenge the validity of difference scores as measures of informant discrepancies.

Distinguishing the Difference Score from the Measures Used to Create It The first problem when examining relations between difference scores and a second variable is that the difference score is composed of two components, namely two informants' reports (e.g., parent report and child report). As such, mathematically, any correlation computed between a difference score and a second variable (e.g., index of child maladjustment) is fully determined by the variances of the two component scores and the correlation of each component score with the second variable. Multiple patterns can give rise to the same difference score correlations. However, a non-zero difference score correlation has only two possible causes. A non-zero difference score correlation can only result from (a) differences in how strongly reports from the two different component scores correlate with the second variable or (b) from differences in the variances of the two component scores (Edwards 1994; Griffin et al. 1999; see also Laird and Weems 2011). Thus, scores from two informants' reports that have equal variance and equal correlations with a given outcome variable *cannot* produce a difference score that is significantly associated with a second variable. Although these constraints to the difference score can most easily be demonstrated using bivariate correlations, the issues that arise from these constraints apply to all covariance-based analyses (e.g., analysis of variance [ANOVA], regression, structural equations modeling [SEM]; Edwards 2009). Similarly, these issues apply regardless of whether the difference score functions as an independent or dependent variable.

Mathematical Constraints Placed on Difference Score Components The second problem with using difference scores to assess informant discrepancies is that difference scores impose constraints on the relations between the component scores and the second variable, and researchers rarely acknowledge or test these constraints (Edwards 1994, 2002). The constraints imposed by testing a directional difference score calculated by subtracting parent reports (P) from child reports (C) can be easily demonstrated using regression equations. The following equation shows an outcome (Y) predicted by the directional difference score (C–P):

$$Y = b_0 + b_1(C - P) + e. \quad (1)$$

The effect of the directional difference score on the outcome is estimated by b_1, the coefficient for the directional difference score term. The equation can be expanded by applying the coefficient to the two component measures as follows:

$$Y = b_0 + b_1(C) - b_2(P) + e. \quad (2)$$

The expanded equation shows that using a directional difference score is equivalent to constraining the coefficients on child and parent reports to be equal in magnitude but opposite in sign (i.e., $b_1 = -b_2$). In other words, testing a directional difference score computed from parent and child reports is equivalent to testing the hypothesis that child reports will be positively associated with the outcome and parent reports will be negatively associated with the outcome. The constraint, which is a general characteristic of directional difference scores, is particularly troublesome when applied to informant discrepancies. Specifically, the study of informant discrepancies is motivated by the lack of agreement between reports from multiple informants. Yet, this does not mean that the informants' reports are orthogonal to each other. Discrepancies occur, even when informants' reports exhibit similar psychometric qualities (e.g., factor structure and item content; De Los Reyes 2011; De Los Reyes et al. 2012c). Further, when informants' reports disagree, they still correlate positively (e.g., Achenbach et al. 1987).

Edwards (1994) demonstrates that squared difference scores and absolute difference scores impose a similar set of constraints on the component coefficients in the expanded models required to test quadratic or absolute difference scores. To our knowledge, no previous study in the developmental psychopathology literature has tested the effects of the constraints imposed by using difference scores. Yet, previous research in organizational psychology shows that the reduction in predictive power produced by the difference score constraints is substantial, and that conclusions based on constrained models often differ widely from conclusions based on the better-fitting models that do not impose constraints (Edwards 1994; Edwards and Harrison 1993).

An Alternative to Difference Scores

Edwards (1994) proposed polynomial regression analyses as an alternative to using difference scores to test agreement or discrepancy-based research questions. Polynomial regression equations will be used in the current study to demonstrate (a) how interaction terms representing variations of informant discrepancy and congruence (e.g., parent report high versus child report low; both parent and child report high) provide a more direct test of informant discrepancy hypotheses than do difference scores and (b) how constraints imposed on regression coefficients can be used to test the validity of analyses based on difference scores.

The polynomial regression model for testing child (C) and parent (P) informant discrepancy hypotheses (as a predictor of Y) is shown in Eq. 3 as follows:

$$Y = b_0 + b_1C + b_2P + b_3C^2 + b_4CP + b_5P^2 + e. \quad (3)$$

When specified in this manner and tested using mean-centered child and parent scores (Cohen et al. 2003), the regression coefficients estimate the linear (b_1) and quadratic (b_3) effects of child reports at mean levels of parent reports, the linear (b_2) and quadratic (b_5) effects of parent reports at mean levels of child reports, and the interaction between child and parent reports (b_4). The quadratic terms are included in the model because the interaction between child and parent reports may reflect the quadric effect of child or parent reports if the quadratic effects are not modeled (Ganzach 1997). Edwards (1994) recommends testing the addition of a set of coefficients one order higher in magnitude (i.e., quadratic interactions and cubic terms) to ensure that the model does not underestimate the complexity of the associations.

The linear (i.e., parent X child) and, when necessary, quadratic (i.e., parent X child-squared and parent-squared X child) interaction terms test whether the association between the child reports and the outcome are moderated by the parent reports (and, because the interaction can be interpreted with either variable serving as the moderator, whether the association between the parent reports and the outcome are moderated by the child reports). The interaction terms provide key tests of informant discrepancies by directly testing whether high (or low) scores from one informant are more or less strongly associated with the outcome when scores from the other informant are also high (or low). In other words, the interaction terms test the fundamental discrepancy hypothesis that associations between an outcome variable and reports provided by one informant vary as a function of the other informants' reports. Unlike difference score associations, however, the interaction terms test conditional associations generally. A single set of interaction terms can test for multiple patterns of informant discrepancies that are commonly tested using different types of difference scores. Post-hoc probing of significant interaction terms is necessary via simple slopes (see Cohen et al. 2003) or response surface plotting (see Edwards 1994, 2002). Post-hoc probing will reveal whether psychosocial maladjustment outcomes are most common when (a) informants disagree regardless of informant levels, (b) informants agree regardless of informant levels, or (c) whether the effect of disagreement or agreement differs as a function of informant levels (e.g., symptoms of psychopathology are common when either informant reports high levels of conflict).

In addition to providing direct tests of discrepancy hypotheses, polynomial regression models can also be used to test the validity of difference score analyses. Edwards (2002) describes how constraints imposed on polynomial regression analyses can be used to assess the validity of analyses using directional difference scores, quadratic difference scores, and absolute difference scores (i.e., using a piece-meal polynomial model to model the deflection point presumed by absolute difference scores). Polynomial regression models provide valid tests of discrepancy hypotheses even when the various constraints imposed on difference scores result in poorer fitting models, because the constraints can be released and interaction terms can be added to the models (Edwards 1994, 2002).

The Current Study

The empirical research on informant discrepancies has largely focused on the degree of agreement or disagreement between informants (and moderators of such agreement or disagreement), and thus research on informant discrepancies has largely minimized the importance of the underlying construct upon which informants disagree (for a review see De Los Reyes and Kazdin 2005). This can be contrasted with theoretical frameworks on informant discrepancies, which have incorporated an understanding of developmental psychopathology into delineating the mechanisms underlying informant discrepancies (e.g., De Los Reyes and Kazdin 2005; Goodman et al. 2010). Therefore, it seems reasonable to propose that not all informant disagreements are the same, and researchers should examine informant discrepancies on measures of behaviors for which discrepant reports may indicate troublesome outcomes.

Along these lines, we tested discrepancies between parent and early adolescent reports of five constructs as predictors of adolescent antisocial behavior and depression. Constructs were selected to represent a broad range of variables associated with psychopathology, for which parents and adolescents are likely to provide discrepant reports (e.g., Collins and Laursen 2006; De Los Reyes et al. 2012c), and for which parent-child disagreement could be particularly problematic during early adolescence. Specifically, the constructs include the extent of parent-adolescent conflict, the extent to which the parent is knowledgeable regarding the adolescent's whereabouts and activities, the degree of parental acceptance of the adolescent, how often the adolescent breaks rules, and the adolescents' degree of pubertal development. Several previous studies have reported significant associations between child psychopathology and a directional difference score calculated using parent and child reports of parental knowledge (e.g., De Los Reyes 2010a), severe forms of rule-breaking (e.g., delinquent behavior; see Ferdinand et al. 2004), and family relationship variables in reference to conflict (e.g., Pelton

and Forehand 2001). However, discrepancies in reports of parental acceptance and pubertal development have not been previously tested as predictors of psychopathology.

Three discrepancy hypotheses were tested with each construct across the two outcomes. The first hypothesis is that higher adolescent reports, relative to parent reports, will be associated with antisocial behavior and depression. Specifically, higher adolescent reports of conflict, rule-breaking, and acceptance are expected to be associated with more antisocial behavior and depression whereas higher adolescent reports of knowledge and acceptance are expected to be associated with less antisocial behavior and depression. The first hypothesis is consistent with the results from previous studies using directional difference scores and was tested using the polynomial regression model and the set of directional difference score constraints. The second hypothesis is that greater discrepancies between parent and adolescent reports will be associated with antisocial behavior and depression. The second hypothesis is consistent with both absolute difference scores and squared difference scores. The second hypothesis was tested using the polynomial regression model and the set of squared difference score constraints. The third hypothesis is that the interaction between parent and child reports will be associated with the outcomes. The third hypothesis was tested directly by the linear, and when necessary, quadratic parent X child interaction terms in the polynomial regression model, and post-hoc probing of the interaction terms was used to identify the pattern of conditional associations.

Method

Participants

Participants included 218 early adolescents and their mothers who were participating in a larger longitudinal study (see Laird and Marrero 2010). Most of the early adolescent participants were 11 years old (M age=11. 5 years, SD= 0.51; Range=10 years, 7 months to 13 years, 9 months). The sample was 51 % female and 73 % of the adolescents lived in a two-parent home when the data were collected. Most adolescent participants were European American, non-Hispanic (49.1 %) or African American (47.2 %; 2.8 % were Asian, and 1 % were Hispanic).

Procedure

Following IRB approval, families were recruited from 5th grade classrooms in 20 public schools serving citizens of Baton Rouge, LA (population about 400,000). About 20 % of the 5th graders recruited participated in the study. Families were provided an overview of the interview procedure before mothers provided informed consent and adolescents provided written assent. To ensure privacy and reduce social desirability bias, participants were interviewed in separate private locations within the home and privately recorded their responses to the questions on an answer sheet. Each participant was compensated $25.

Measures

Informant Discrepancy Variables

Conflict Mother-adolescent conflict was measured using 10 items modeled on Robin and Foster's (1989) assessment. More adolescent-reported conflict was found to be associated with less antisocial behavior and less depression in a previous study using a portion of the current dataset (Sentse and Laird 2010). For each item (e.g., cleaning your room, hanging out with friends that parents do not like) adolescents and mothers reported the frequency of conversation during the past four weeks using a 3-point scale from never (coded 0) to lots of times (coded 2). For items that were discussed, adolescents and mothers also responded to a question assessing the anger expressed during the discussions using a 3-point scale from *calm* (coded 0) to *very angry* (coded 2). Following Robin and Foster's (1989) scoring procedure, the frequency and anger scores were multiplied for each item. Adolescent-reported and mother-reported conflict composite scores were computed as the mean of the respective 10 items (α=0.67 & 0.79). Higher conflict scores indicate more frequent and intense conflict.

Parental Knowledge To assess mothers' knowledge of adolescents' whereabouts and activities, mothers and adolescents responded to 10 items (e.g., "How much does your mother really know about what you do with your free time?") adapted from Brown et al. (1993) and Dishion et al. (1991). Parental knowledge is consistently associated with conduct problems and psychopathology (Dishion and McMahon 1998; Racz and McMahon 2011). Each item was scored using a five-point response scale ranging from *she doesn't know* (scored 0) to *she knows everything* (scored 4). Adolescent-reported and mother-reported knowledge scores were computed as the mean of the respective 10 items (αs= 0.78 & 0.70). Higher scores indicate more knowledgeable parents.

Acceptance To measure parental acceptance, mothers and adolescents responded to 14 items from the Children's Report of Parental Behavior Inventory (CRPBI; Schaefer 1965; Schludermann and Schludermann 1988). More adolescent-reported parental acceptance was found to be associated with less antisocial behavior and less depression in a previous study using a portion of the current dataset

(Sentse and Laird 2010). Adolescents and mothers reported how much each item (e.g., "My mother tells me she loves me") reflected their mother's behavior on a 5-point scale from *not at all like her* (scored 0) to *a lot like her* (scored 4). Adolescent-reported and mother-reported acceptance scores were computed as the mean of the respective 14 items (αs= 0.92 & 0.90). Higher scores indicate more parental acceptance.

Rule-Breaking Adolescents and mothers reported the adolescents' rule-breaking behavior using the Teen Conflict Survey (Bosworth and Espelage 1995). More adolescent-reported rule-breaking was found to be associated with more antisocial behavior but not with more depression in a previous study using a portion of the current dataset (Laird and Marrero 2010). The six items measure the frequency of rule-breaking behavior at home, school, and other contexts and how often the child has been in trouble at home, school, and other contexts. Items are scored on a five point scale ranging from *never* (scored 0) to *7 or more times* (scored 4). Separate adolescent-reported and mother-reported rule-breaking scores were computed as the mean of the respective six items (αs=0.82 & 0.79). Higher scores indicate more frequent rule-breaking.

Pubertal Development To assess pubertal development, mothers and adolescents completed the Pubertal Development Scale (PDS: Petersen et al. 1988). Higher PDS scores, indicating more advanced pubertal development, were found to be associated with weaker authority beliefs, earlier autonomy expectations, more unsupervised time, and less parental knowledge in a previous study using a portion of the current dataset (Laird and Marrero 2011). The PDS includes 3 items for all participants assessing growth spurts, body hair, and skin changes. Two additional items for males ask about voice changes and facial hair and two additional items for females ask about breast growth and whether menstruation has begun. The menstruation item is dichotomous. Mothers and adolescents responded to the remaining items using a four-point scale from *has not yet begun* (scored 1) to *seems complete* (scored 4). Separate adolescent-reported and parent-reported puberty scores were calculated using the scoring algorithm developed by Shirtcliff et al. (2009) that recalibrates scoring of each item according to the appropriate Tanner Stages. Higher scores indicate more advanced pubertal development.

Outcome Variables

Antisocial Behavior Adolescents reported the frequency of their involvement in antisocial behavior using the Problem Behavior Frequency Scale (Farrell et al. 2000) which assesses physical and non-physical aggression, delinquency, and drug use using a total of 26 items. All items were scored on a five-point scale from *never* (scored 0) to *7 or more times* (scored 4) in the past 30 days. The mean of the 26 items was computed to index antisocial behavior (α=0.91). Higher scores indicate more frequent involvement in antisocial behavior.

Depression Adolescents reported their own depressive symptoms using the six-item Modified Depression Scale (MDS; Orpinas 1993). The MDS is based on the DSM scale for depression and assesses past 30-day frequency of six depressive symptoms (i.e., sadness, irritability, hopelessness, sleep disturbance, difficulty concentrating, and eating problems; Dahlberg et al. 2005). Each item was scored on a five point scale from *never* (scored 0) to *always* (scored 4). Depression scores were computed as the mean of the six items (α=0.75). Higher scores indicate more depressive symptoms.

Analysis Plan

Three types of difference scores were computed from mother and adolescent reports. A directional difference score (D) was computed by subtracting mother reports from adolescent reports. The directional difference in standardized reports (DZ) was computed by standardizing mother and adolescent reports before subtracting mother reports from adolescent reports. A squared difference score (D^2) was computed by squaring the directional difference score. Analyses tested the correlations linking antisocial behavior and depression with each difference score.

Polynomial regression equations were used to test the directional difference score, squared difference score, and interaction hypotheses. Antisocial behavior and depression were regressed on parent and adolescent reports of each predictor variable. Each outcome was paired with each predictor variable in ten separate regression analyses. Analyses had sufficient power (0.80) to detect relatively small effects, f^2=0.036, using a two-tailed test with a p-value of 0.05 (for comparison, Cohen (1988) labeled f^2=0.02 as a small effect and f^2=0.15 as a medium effect). Each regression model included four terms: the adolescent report, the mother report, the adolescent report squared, a multiplicative interaction term computed by multiplying the mother and adolescent report, and the mother report squared. Mother and teen reports were mean-centered. Two sets of constraints were tested as recommended by Edwards (1994). Four constraints were imposed to test the directional difference score model. The coefficient for adolescent reports and mother reports were constrained to be equal in magnitude but opposite in direction (i.e., $b_1=-b_2$ from Eq. 3), and the coefficients for the two quadratic terms and the multiplicative interaction term were constrained to be equal to zero

(i.e., $b_3=0$, $b_4=0$, $b_5=0$ from Eq. 3). A different set of four constraints was imposed to test the squared difference score model. Specifically, the coefficients for adolescent reports and mother reports were constrained to be equal to zero (i.e.. $b_1=0$ and $b_2=0$ from Eq. 3), the coefficients for the two quadratic terms were constrained to be equal (i.e., $b_3=b_5$ from Eq. 3), and the coefficient for the interaction term was constrained to be twice as large as the coefficient for the quadratic terms, but with the opposite valence (i.e., $b_4=-2b_3$ which also means $b_4=-2b_5$, because $b_3=b_5$ from Eq. 3). Finally, four higher order terms (the adolescent report cubed, mother report X adolescent report squared, adolescent report X mother report squared, the mother report cubed) were added to the model when the addition significantly improved the fit of the model as recommended by Edwards (1994). Significant interaction terms were interpreted by plotting predicted values and calculating simple slopes at high (+1*SD*) and low (−1*SD*) levels of the moderator as recommended by Cohen et al. (2003). Because the interaction terms can be interpreted with either informant as the moderator, for each significant interaction term, we present the figure that provides the most insight into the relation between the informant discrepancy and the associated outcome variable.

Results

Three sets of analyses were conducted. The first set of analyses assessed the congruence between mother and adolescent reports of conflict, knowledge, acceptance, rule-breaking behavior, and pubertal development. The second set of analyses tested correlations linking adolescent-reported antisocial behavior and depression with mother and adolescent reports of the five predictors and with three types of difference scores calculated from mother and adolescent reports. The goal of the first two sets of analyses was to describe the nature of parent-adolescent discrepancies across the predictor and outcome variables, to test difference scores associations, and to determine whether differences in variance or correlations underlie the difference score associations. The goal of the third set of analyses was to test the three discrepancy hypotheses using polynomial regression equations. The equations predicted antisocial behavior and depression from mother and adolescent reports. Analyses tested constraints imposed by difference score and squared difference score models as well as the parent-adolescent interaction terms.

Congruence Between Mother and Adolescent Reports

Three aspects of the congruence between mother and adolescent reports were tested. First, mean-level differences between mother and adolescent reports were tested via paired t-tests. As shown in Table 1, mothers reported more conflict, more knowledge, and more acceptance than did adolescents. Adolescents reported more rule-breaking and more advanced pubertal development than did mothers. Second, the variance in mother and adolescent reports of each predictor was tested using an equality constraint imposed when modeling the variance-covariance matrix of the two reports. Constraints were tested using the Model Test command in Mplus 6.0 (Muthén and Muthén 2010). There was more variance in mother reports of conflict than in adolescent reports of conflict. In contrast, there was more variance in adolescent reports of knowledge, acceptance, and rule-breaking behavior than in the respective mother reports. Third, associations between mother and adolescent reports were tested using bivariate correlations. As shown in Table 1, mother and adolescent reports of conflict, knowledge, rule-breaking, and pubertal development, but not acceptance, were positively and significantly correlated.

Associations Between Outcomes and Parent Reports, Adolescent Reports, and Difference Scores

Bivariate correlations linking adolescent-reported antisocial behavior and depression with mother and adolescent reports of each of the five predictor variables were estimated. The difference between each mother and adolescent correlation was tested using an equality constraint when modeling the set of three correlations (i.e., covariances among standardized variables) interlinking the mother report, the adolescent report, and the outcome variable. Constraints were tested using the Model Test command in Mplus 6.0 (Muthén and Muthén 2010). Correlations between each difference score and antisocial behavior and depression also were calculated.

As shown in Table 2, both mother and adolescent reports of more conflict and rule-breaking and less knowledge and acceptance were associated with more adolescent-reported antisocial behavior. The mother-reported and adolescent-reported conflict correlations did not differ significantly from one another and none of the conflict difference scores were associated with antisocial behavior. In contrast, the mother-reported and adolescent-reported knowledge, acceptance, rule-breaking, and puberty correlations did differ significantly from one another and all of the raw directional and standardized directional difference scores were associated with antisocial behavior.

Adolescent reports of more conflict, less knowledge, less acceptance, more rule-breaking, and more pubertal development were associated with more adolescent-reported depression. None of the parent reports were associated significantly with depression. Adolescent-reported correlations for conflict, knowledge, rule-breaking, and puberty differed significantly from their parent-reported counterparts

Table 1 Congruence between parent and adolescent reports

	Parent report	Adolescent report	Difference in means			Difference in variance		Association between parent and adolescent reports	
	M (SD)	*M (SD)*	*df*	*T*	*p*	$X^2(1)$	*p*	*r*	*p*
Conflict	3.49 (1.28)	3.18 (1.11)	216	2.97	0.003	4.16	0.041	0.17	0.012
Knowledge	4.51 (0.35)	4.16 (0.61)	217	8.98	<0.001	49.18	<0.001	0.36	<0.001
Acceptance	4.63 (0.49)	4.26 (0.77)	217	6.18	<0.001	31.95	<0.001	0.08	0.219
Rule-breaking	1.83 (0.60)	2.00 (0.77)	217	−2.91	0.004	13.33	<0.001	0.27	<0.001
Puberty	2.68 (1.01)	2.93 (1.09)	215	−3.50	<0.001	1.91	0.167	0.52	<0.001

and their raw directional and standardized directional difference scores were associated with depression.

Polynomial Regression Equations

Testing the Validity of Difference Scores Tables 3 and 4 present results from the polynomial regression analyses. There are four conditions that must be met to interpret directional difference scores or quadratic difference score correlations with outcome variables (Edwards 1994). The first condition is that the polynomial regression model (without the higher order interaction terms) accounts for a significant amount of variance in the outcome. The first condition was met in 18 of the 20 cases. The second condition is that the regression coefficients follow the expected pattern. For directional difference scores, the key feature of the expected pattern is that the coefficients for mother and adolescent reports are both statistically significant predictors of the outcome, but that they differ in valence. For quadratic difference scores, the key feature of the expected pattern is that the coefficients for quadratic terms and the interaction terms are significant predictors of the outcome. The coefficients never followed the expected pattern and thus the second condition was not met in any of the difference score analyses. The third condition is that the constraints did not worsen the fit of the model. In four cases (out of 20), the constraints did not worsen the fit of the model. However, in each case, the constraints did not worsen the fit of the model because all constrained parameters did not differ significantly from zero. The fourth condition is that higher order terms do not improve the fit of the model. The fourth condition was met in twelve of the 20 models. In sum, there was not a single analysis in which all conditions required for the use of directional difference scores or quadratic difference scores were met. Results testing the absolute difference scores constraints using a piecemeal regression model and results using standardized variables to test the DZ score constraints are not reported but they led to identical conclusions and are available from the first author.

Testing Interaction Terms Across the ten polynomial regression models, five parent-adolescent interaction terms were

Table 2 Correlations between outcomes and parent reports, adolescent reports, and difference scores

Predictor	Individual informant correlations		Testing difference in correlations		Difference score correlations		
	Parent report	Adolescent report	$X^2(1)$	p_{diff}	*D*	*DZ*	D^2
	Antisocial behavior						
Conflict	0.23***	0.33***	1.26	0.262	0.05	0.08	0.04
Knowledge	−0.14*	−0.35***	6.77	0.009	−0.28***	−0.18***	0.15*
Acceptance	−0.02	−0.20**	3.98	0.046	−0.17*	−0.14*	0.08
Rule-breaking	0.25***	0.60***	16.41	<0.001	0.37***	0.29***	0.30***
Puberty	−0.03	0.14*	5.79	0.016	0.17*	0.16*	0.10
	Depression						
Conflict	0.09	0.35***	8.27	0.004	0.18**	0.20**	0.07
Knowledge	−0.10	−0.34***	9.53	0.002	−0.30***	−0.21**	0.27***
Acceptance	−0.11	−0.22***	1.49	0.223	−0.13	−0.08	0.15*
Rule-breaking	0.08	0.41***	15.18	<0.001	0.32***	0.27***	0.12
Puberty	0.04	0.20**	5.26	0.022	0.17*	0.16*	0.04

D = raw adolescent scores minus raw mother scores, *DZ* = difference between standardized scores, D^2 = squared difference between raw scores, * p <0.05, ** p<0.01, *** p<0.001

Table 3 Parent and adolescent (adol.) reports as predictors of antisocial behavior (polynomial regression)

	Conflict			Knowledge			Acceptance			Rule-breaking			Puberty		
Parameter	*B*	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*P*	*B*	*SE*	*p*	*B*	*SE*	*p*
Adol. report	0.123	0.028	<0.001	−0.326	0.063	<0.001	−0.200	0.054	<0.001	0.257	0.045	<0.001	0.035	0.076	0.647
Parent report	0.061	0.028	0.027	0.052	0.099	0.598	−0.005	0.103	0.964	0.076	0.061	0.212	−0.016	0.073	0.828
Adol. squared	−0.005	0.018	0.787	−0.112	0.049	0.023	−0.077	0.034	0.023	0.026	0.057	0.655	0.025	0.027	0.350
Adol. X parent	0.029	0.020	0.146	0.142	0.129	0.271	−0.031	−0.368	0.713	−0.025	0.088	0.776	−0.029	0.038	0.440
Parent squared	−0.003	0.012	0.817	0.104	0.197	0.596	−0.018	0.095	0.849	0.156	0.100	0.117	−0.001	0.035	0.966
Adol. cubed										−0.005	0.021	0.828	0.048	0.024	0.044
Parent X adol. squared										0.143	0.042	0.001	−0.078	0.033	0.019
Adol. X parent squared										0.054	0.077	0.483	−0.035	0.037	0.343
Parent cubed										−0.134	0.061	0.028	0.029	0.031	0.349
Model R^2	0.149	0.045	0.001	0.145	0.044	0.001	0.063	0.032	0.048	0.461	0.050	<0.001	0.083	0.036	0.021
Parameter constraints	X^2 (4)	*p*		X^2 (4)	*P*		X^2 (4)	*P*		X^2 (4)	*P*		X^2 (4)	*p*	
Directional difference score Constraints	37.39	<0.001		17.45	0.002		8.26	0.082		99.26	<0.001		2.03	0.730	
Squared difference score constraints	37.36	<0.001		36.308	<0.001		14.51	0.006		128.23	<0.001		7.68	0.104	
Higher order terms removed	2.53	0.639		7.76	0.101		0.546	0.969		22.37	<0.001		10.77	0.029	

Table 4 Parent and adolescent (adol.) reports as predictors of depression (polynomial regression)

	Conflict			Knowledge			Acceptance			Rule-breaking			Puberty		
Parameter	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
Adol. report	0.261	0.053	<0.001	−0.517	0.117	0.000	−0.266	0.120	0.027	0.464	0.099	<0.001	0.183	0.060	0.002
Parent report	0.074	0.051	0.153	−0.079	0.184	0.668	0.054	0.207	0.795	−0.085	0.135	0.527	−0.065	0.064	0.313
Adol. squared	0.000	0.034	0.993	−0.016	0.092	0.862	−0.270	0.162	0.095	−0.138	0.127	0.276	−0.016	0.049	0.746
Adol. X parent	−0.074	0.037	0.046	−0.298	0.241	0.215	−0.209	0.308	0.497	−0.370	0.195	0.058	0.018	0.071	0.796
Parent squared	−0.029	0.023	0.196	−0.307	0.368	0.404	−1.26	0.527	0.017	0.235	0.220	0.285	−0.030	0.063	0.635
Teen cubed							−0.087	0.059	0.140	−0.006	0.047	0.900			
Parent X adol. squared							−0.439	0.165	0.008	0.138	0.092	0.135			
Adol. X parent squared							0.009	0.280	0.976	0.377	0.171	0.027			
Parent cubed							−0.761	0.288	0.008	−0.199	0.135	0.141			
Model R^2	0.147	0.044	<0.001	0.139	0.044	0.001	0.139	0.043	0.001	0.241	0.050	0.001	0.045	0.028	0.103
Parameter constraints	X^2 (4)	*p*		X^2 (4)	*p*		X^2 (4)	*P*		X^2 (4)	*p*		X^2 (4)	*p*	
Directional difference score constraints	29.44	<0.001		12.87	0.012		9.70	0.046		25.85	<0.001		4.04	0.401	
Squared difference score constraints	33.76	<0.001		24.66	<0.001		10.55	0.032		52.88	<0.001		10.13	0.038	
Higher order terms removed	3.38	0.500		5.67	0.225		20.08	<0.001		12.52	0.014		1.50	0.827	

significant as shown in Tables 3 and 4. The interaction between parent-reported rule-breaking and the quadratic effect of adolescent-reported rule-breaking was a predictor of antisocial behavior. The interaction was interpreted with parent-reported rule-breaking serving as the moderator to facilitate plotting of the quadratic effect for adolescent-reported rule-breaking. As shown in Fig. 1, the quadratic effect is positive for adolescent-reported rule breaking at high levels of parent-reported rule-breaking, b=0.11, SE=0.07, p=0.095, but negative at low levels of parent-reported rule-breaking, b=−0.06, SE=0.07, p=0.37, indicating that the congruence of high adolescent-reported rule-breaking and high parent-reported rule-breaking is associated with the highest levels of antisocial behavior.

The interaction between parent-reported puberty and the quadratic effect of adolescent-reported puberty was a predictor of antisocial behavior. The interaction was interpreted with parent -reported puberty serving as the moderator to facilitate plotting of the quadratic effect for adolescent-reported puberty. As shown in Fig. 2, the quadratic effect is positive for adolescent-reported puberty at low levels of parent-reported puberty, b=0.11, SE=0.04, p=0.003, but negative at high levels of parent-reported puberty, b=−0.06, SE=0.04, p=0.11, indicating that the discrepancy of low parent-reported puberty and high adolescent-reported puberty is associated with the highest levels of antisocial behavior.

The linear interaction between parent and adolescent reports of conflict was a predictor of depression. The interaction was interpreted with parent-reported conflict serving as the moderator. As shown in Fig. 3, more adolescent-reported conflict was more strongly associated with more depression at low levels of parent-reported conflict, b=0.36, SE=0.07, p<0.001, than at high levels of parent-reported conflict, b=0.17, SE=0.07, p=0.02, indicating that the congruence of low parent-reported conflict and low adolescent-reported conflict is associated with the lowest levels of depression.

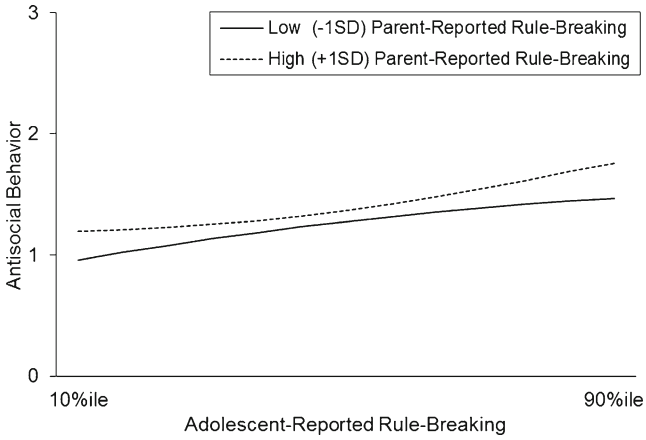


Fig. 1 Predicted values of antisocial behavior as a function of adolescent-reported rule-breaking at high and low values of parent-reported rule-breaking

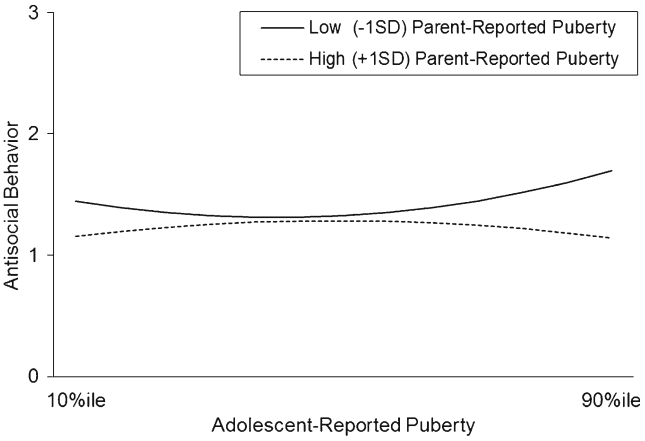


Fig. 2 Predicted values of antisocial behavior as a function of adolescent-reported puberty at high and low values of parent-reported puberty

The interaction between parent-reported acceptance and the quadratic effect of adolescent-reported acceptance was a predictor of depression. The interaction was interpreted with parent-reported acceptance serving as the moderator to facilitate plotting of the quadratic effect for adolescent-reported acceptance. As shown in Fig. 4, the negative quadratic effect is stronger for adolescent-reported acceptance at high levels of parent-reported acceptance, b=−0.49, SE=0.17, p=0.004, than at low levels of parent-reported acceptance, b=−0.06, SE=0.193, p=0.78, indicating that the congruence of high parent-reported acceptance and high adolescent-reported acceptance is associated with the lowest levels of depression.

Finally, the interaction between adolescent-reported rule-breaking and the quadratic effect of parent-reported rule-breaking was a predictor of depression. The interaction was interpreted with adolescent-reported rule-breaking serving as the moderator to facilitate plotting of the quadratic effect

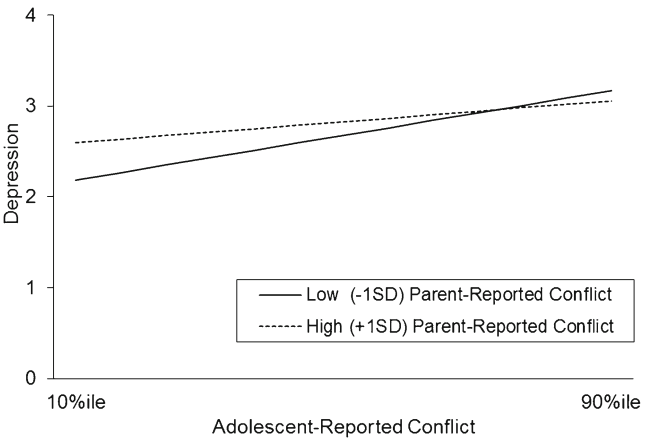


Fig. 3 Predicted depression values as a function of adolescent-reported conflict at high and low levels of parent-reported conflict

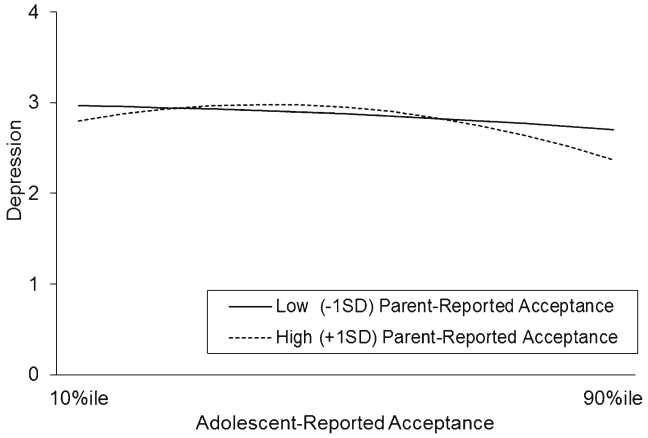


Fig. 4 Predicted depression values as a function of adolescent-reported acceptance at high and low levels of parent-reported acceptance

for parent-reported rule-breaking. As shown in Fig. 5, the quadratic effect is positive for parent-reported rule-breaking at high levels of adolescent-reported rule-breaking, $b=0.53$, $SE=0.29$, $p=0.08$, but negative at low levels of adolescent-reported rule-breaking, $b=-0.06$, $SE=0.21$, $p=0.79$, indicating that discrepancy of high adolescent-reported rule-breaking and low parent-reported rule-breaking is associated with the highest levels of depression.

In sum, the four interaction terms showed that antisocial behavior was high when parents and adolescents agreed that adolescents were engaging in high rates of rule-breaking behavior and when mothers disagreed with adolescents' reports of advanced pubertal development. High levels of depression were found when mothers disagreed with adolescents' reports of high rates of rule-breaking behavior. In contrast, low levels of depression were found when parents and adolescents agreed that conflict levels were low or acceptance levels were high.

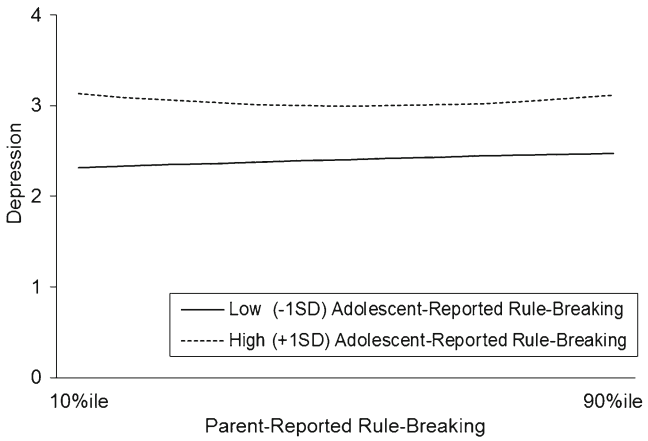


Fig. 5 Predicted depression values as a function of parent-reported rule-breaking at high and low levels of adolescent-reported rule-breaking

Discussion

Analyses demonstrate substantial discrepancies in mother and adolescent reports of parent-adolescent conflict, parental knowledge and acceptance, and adolescent rule-breaking and pubertal development. Although difference scores computed from mother and adolescent reports were linked with antisocial behavior and depression, analyses demonstrate that the mother and adolescent reports differ in variance and differ in their bivariate associations with antisocial behavior and depression. Unequal variability and bivariate associations are responsible for the difference score correlations. The difference score models did not provide a good fit to the data. Further, the implied difference score constraints worsened the fit of models linking independent informants' scores with antisocial behavior and depression. Taken together, these findings demonstrate that difference scores cannot validly assess informant discrepancies. In contrast, five of the eighteen multi-informant interaction terms were significant predictors of antisocial behavior or depression. Importantly, using a technique that correctly models informant congruence and discrepancy (i.e., polynomial regression), our findings provide evidence that informant discrepancies predict unique variance in adolescent psychopathology, above-and-beyond the contributions of the individual informants' reports used to examine discrepancies.

Difference Scores are Not Valid Assessments of Informant Discrepancies The use of polynomial regression techniques reveals the limitations of difference scores; difference score correlations may lead to conclusions that are not supported by a more complete examination of the data (Edwards 1994; Laird and Weems 2011). Analyses directly addressed two difference score limitations. First, difference scores can be correlated with an outcome only when the two components of the difference score have unequal variances or when the correlations between the outcome and the two components are unequal (Edwards 1994; Griffin et al. 1999; Laird and Weems 2011). Unequal informant correlations appear to be primarily responsible for the apparent difference score effects in the current study. Indeed, all directional difference score correlations remained significant when the difference score was computed using standardized scores, which equate informant variances. Studies contrasting parents or adolescents with other informants, such as teachers or observers, may find that informant variances more commonly underlie the difference score correlations. Second, difference scores impose a set of constraints that are rarely directly tested (Edwards 1994, 2002). Constraints were found to significantly worsen model fit in sixteen out of twenty models. Moreover, constraints in the remaining four models did not worsen model fit because none of the constrained parameters differed from zero. Taken as a whole,

analyses clearly show that previous conclusions based on difference score correlations are not supported by a more comprehensive examination of the data.

Researchers seeking to identify situations or contexts within which informant discrepancies are predictive should note that the limitations of difference scores described in this paper are not limited to bivariate correlations. When difference scores serve as the input to even highly sophisticated data analyses, the analyses suffer from the same inherent limitations as do simple bivariate correlations (Edwards 2009). In fact, the limitations are likely compounded by the lack of transparency of the analyses and the tighter restrictions and assumptions that often accompany such analyses. The implication of the current study is that all analyses of informant discrepancies based on difference scores are flawed unless the constraints imposed by the difference scores are tested and found to be acceptable.

Difference Scores May Not Be Valid Assessments of Any Construct Researchers seeking to address research questions outside of the informant discrepancies literature should bear in mind that the limitations of difference scores described in this paper are fundamental limitations of difference scores as representations of *any* construct. Importantly, it is easy to identify instances in which difference score critiques have been successful in reducing the use of difference scores to answer one research question (e.g., Edwards 1994; Griffin et al. 1999), only to see the use of difference scores emerge as a newly adopted analytic tool in another area.

Our hope is that this paper contributes to reducing the use of difference scores in multiple areas of developmental psychopathology research. For example, recently difference scores have been used to test Moffitt's (1993) maturity gap hypothesis (e.g., Barnes et al. 2011). Difference scores have also been used to test whether discrepancies between mothers' and fathers' parenting styles or behaviors are linked to child misbehavior (e.g., Nelson et al. 2006). In these areas, differences in component correlations or differences in variance must underlie the difference score correlations. However, similar to the informant discrepancies literature, researchers have neither recognized the source of the effect nor tested the constraints imposed by the difference scores.

Informant Discrepancies (as Measured by Interactions) Predict Psychopathology The current study did find evidence that informant discrepancies account for unique variance in adolescent psychopathology. Five interaction terms explained unique variance in antisocial behavior or depression. Inspection of fitted regression lines (i.e., Figs. 1, 2, 3, 4 and 5), clearly shows that informant discrepancies add an important nuance to interpretations of developmental psychopathology findings. These important contributions to knowledge about developmental psychopathology may be missed if one only considers the additive main effects of parent and adolescent reports, or perhaps worse, only assesses risk factors of psychopathology with a single informant's report (e.g., studies relying only on self-reports to assess risk factors).

Interaction terms identified three different multi-informant patterns that were linked to psychopathology. First, congruence among informants when reporting symptoms or risk factors may be especially informative. Antisocial behavior levels were highest when there was congruence among informants reporting high levels of rule-breaking behavior. This suggests that psychopathology may be most pronounced when multiple informants agree on the presence of symptoms. Second, congruence among informants when reporting on positive aspects of the parent-child relationship may be especially informative. Depression levels were the lowest when there was congruence among informants reporting low levels of conflict and high levels of acceptance, suggesting that psychopathology may be least common when informants agree that the parent-child relationship is characterized by positive interactions. Third, the mismatch between parent and child perspectives is particularly informative. Antisocial behavior was most common when adolescents' reported advanced pubertal maturation but parents reported minimal pubertal maturation. Likewise, depression was most common when adolescents reported high levels of rule-breaking but parents reported low levels of rule-breaking. Researchers are encouraged to test additional predictor-outcome associations using interaction terms in polynomial regression models to determine the prevalence and generalizability of these three different multi-informant patterns as predictors of child psychopathology.

Concluding Comments

The current study demonstrates that testing interaction terms in polynomial regression analyses is relatively more valid for examining discrepancies between informants' reports than testing difference scores between these same reports. However, findings also point to the need to conceptualize informant discrepancies not as an isolated and independent construct, but rather to conceptualize informant discrepancies as the degree of congruence or discrepancy in reports of a specific construct. That is, the meaning of congruence or discrepancy likely varies as a function of the construct being assessed and the outcome to which it is linked. Furthermore, the preponderance of significant interactions including quadratic terms suggests that the predictive utility of informant discrepancies is most pronounced at the extremes.

Researchers have previously relied on difference score correlations to argue that informant discrepancies predict

child and adolescent psychopathology. The current study demonstrates that difference score correlations do not provide evidence that informant discrepancies predict psychopathology. Yet, analyses demonstrate that interaction terms support the predictive utility of informant discrepancies. The current study joins many others in demonstrating that there are large discrepancies when multiple informants report using parallel measures, even when each individual report is demonstrated to be reliable and valid (De Los Reyes 2011; De Los Reyes et al. 2012a). Likewise, it remains likely that informant discrepancies reflect differences in reporters' access to information (e.g., context-specific observations of behavior) that serves as the basis for their reports (De Los Reyes et al. 2009, 2010a). Further, studies that systematically test multi-informant interactions are likely to find that discrepancy or congruence patterns add important information that is not captured by additive main effects models (see also De Los Reyes et al. 2010b).

Ultimately, informant discrepancies are most troubling for researchers and clinicians because they produce inconsistent conclusions across all types of studies of child and adolescent psychopathology and can lead to different estimates of such parameters as prevalence of mental disorders and treatment response (De Los Reyes 2011). Thus, there are good reasons for seeking to better understand the origins and implications of informant discrepancies. The available theoretical models of informant discrepancies (Achenbach et al. 1987; De Los Reyes and Kazdin 2005; Goodman et al. 2010; Kraemer et al. 2003) remain useful heuristics for systematically studying mechanisms and developmental consequences of informant discrepancies. However, researchers testing hypotheses drawn from these models should avoid using difference scores of any type, as they are very likely to produce inaccurate conclusions. Polynomial regression analyses provide more comprehensive and accurate tests of discrepancy hypotheses.

References

Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: implications of cross-informant correlations for situational specificity. *Psychological Bulletin, 101*, 213–232. doi:10.1037//0033-2909.101.2.213.

Barnes, J. C., Beaver, K. M., & Piquero, A. R. (2011). A test of Moffitt's hypotheses of delinquency abstention. *Criminal Justice and Behavior, 38*, 690–709. doi:10.1177/0093854811405282.

Bosworth, K., & Espelage, D. (1995). *Teen conflict survey*. Center for Adolescent Studies, Indiana University.

Brown, B. B., Mounts, N., Lamborn, S. D., & Steinberg, L. (1993). Parenting practices and peer group affiliation in adolescence. *Child Development, 64*, 467–482. doi:10.1111/j.1467-8624.1993.tb02922.x.

Cohen, J. (1988). *Statistical power analyses for the behavioral sciences* (2nd ed.). Mahwah: Erlbaum.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation for the behavioral sciences* (3rd ed.). Mahwah: Erlbaum.

Collins, W. A., & Laursen, B. (2006). Parent-adolescent relationships. In P. Noller & J. Feeney (Eds.), *Close relationships: Functions, forms, and processes* (pp. 111–125). New York: Psychology Press.

Dahlberg, L. L., Toal, S. B., Swahn, M., & Behrens, C. B. (2005). *Measuring violence related attitudes, behaviors, and influences among youth: A compendium of assessment tools*. Atlanta: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

De Los Reyes, A. (2011). Introduction to the special section: more than measurement error: discovering meaning behind informant discrepancies in clinical assessments of children and adolescents. *Journal of Clinical Child and Adolescent Psychology, 40*, 1–9. doi:10.1080/15374416.2011.533405.

De Los Reyes, A. (2012). Strategic objectives for improving understanding of informant discrepancies in developmental psychopathology research. *Development and Psychopathology*.

De Los Reyes, A., & Kazdin, A. E. (2004). Measuring informant discrepancies in clinical child research. *Psychological Assessment, 16*, 330–334. doi:10.1037/1040-3590.16.3.330.

De Los Reyes, A., & Kazdin, A. E. (2005). Informant discrepancies in the assessment of childhood psychopathology: a critical review, theoretical framework, and recommendations for further study. *Psychological Bulletin, 131*, 483–509. doi:10.1037/0033-2909.131.4.483.

De Los Reyes, A., & Kazdin, A. E. (2006). Conceptualizing changes in behavior in intervention research: the range of possible changes model. *Psychological Review, 113*, 554–583. doi:10.1037/0033-295X.113.3.554.

De Los Reyes, A., & Kazdin, A. E. (2008). When the evidence says, "Yes, no, and maybe so": attending to and interpreting inconsistent findings among evidence-based interventions. *Current Directions in Psychological Science, 17*, 47–51. doi:10.1111/j.1467-8721.2008.00546.x.

De Los Reyes, A., & Kazdin, A. E. (2009). Identifying evidence-based interventions for children and adolescents using the range of possible changes model: a meta-analytic illustration. *Behavior Modification, 33*, 583–617. doi:10.1177/0145445509343203.

De Los Reyes, A., Henry, D. B., Tolan, P. H., & Wakschlag, L. S. (2009). Linking informant discrepancies to observed variations in young children's disruptive behavior. *Journal of Abnormal Child Psychology, 37*, 637–652. doi:10.1007/s10802-009-9307-3.

De Los Reyes, A., Goodman, K. L., Kliewer, W., & Reid-Quiñones, K. (2010a). The longitudinal consistency of mother-child reporting discrepancies of parental monitoring and their ability to predict child delinquent behaviors two years later. *Journal of Youth and Adolescence, 39*, 1417–1430. doi:10.1007/s10964-009-9496-7.

De Los Reyes, A., Reynolds, E. K., Wang, F., MacPherson, L., & Lejuez, C. W. (2010b). Discrepancy between how children perceive their own alcohol risk and how they perceive alcohol risk for other children longitudinally predicts alcohol use. *Addictive Behaviors, 35*, 1061–1066. doi:10.1016/j.addbeh.2010.07.006.

De Los Reyes, A., Youngstrom, E. A., Pabón, S. C., Youngstrom, J. K., Feeny, N. C., & Findling, R. L. (2011). Internal consistency and associated characteristics of informant discrepancies in clinic referred youths age 11 to 17 years. *Journal of Clinical Child and Adolescent Psychology, 40*, 36–53. doi:10.1080/15374416.2011.533402.

De Los Reyes, A., Aldao, A., Thomas, S. A., Daruwala, S. E., Swan, A. J., Van Wie, et al. (2012a). Adolescent self-reports of social anxiety: can they disagree with objective psychophysiological measures and still be valid? *Journal of Psychopathology and Behavioral Assessment*. Advance online publication. doi:10.1007/s10862-012-9289-2.

De Los Reyes, A., Ehrlich, K. B., Swan, A. J., Luo, T., Van Wie, M., & Pabón, S. C. (2012b). An experimental test of whether

informants can report about child and family behavior based on settings of behavioral expression. *Journal of Child and Family Studies*. Advance online publication. doi:10.1007/s10826-012-9567-3.

De Los Reyes, A., Thomas, S. A., Swan, A. J., Ehrlich, K. B., Reynolds, E. K., Suarez, L., et al. (2012c). "It depends on what you mean by 'disagree'": differences between parent and child perceptions of parent-child conflict. *Journal of Psychopathology and Behavioral Assessment*. Advance online publication. doi:0.1007/s10862-012-9288-3.

Dishion, T. J., & McMahon, R. J. (1998). Parental monitoring and the prevention of child and adolescent problem behavior: a conceptual and empirical formulation. *Clinical Child and Family Psychology Review, 1*, 61–75. doi:10.1023/A:1021800432380.

Dishion, T. J., Patterson, G. R., Stoolmiller, M., & Skinner, M. L. (1991). Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. *Developmental Psychology, 27*, 172–180. doi:10.1037/0012-1649.27.1.172.

Edwards, J. R. (1994). The study of congruence in organizational behavior research: critique and a proposed alternative. *Organizational Behavior and Human Decision Processes, 58*, 51–100. doi:10.1006/obhd.1994.1029.

Edwards, J. R. (2002). Alternatives to difference scores: Polynomial regression analysis and response surface methodology. In F. Drasgow & N. Schmitt (Eds.), *Measuring and analyzing behavior in organizations: Advances in measurement and data analysis* (pp. 350–400). San Francisco: Jossey-Bass.

Edwards, J. R. (2009). Latent variable modeling in congruence research: current problems and future directions. *Organizational Research Methods, 12*, 34–62. doi:10.1177/1094428107308920.

Edwards, J. R., & Harrison, R. V. (1993). Job demands and worker health: three-dimensional reexamination of the relationship between person-environment fit and strain. *Journal of Applied Psychology, 78*, 628–648. doi:10.1037/0021-9010.78.4.628.

Farrell, A. D., Kung, E. M., White, K. S., & Valois, R. F. (2000). The structure of self-reported aggression, drug use, and delinquent behaviors during early adolescence. *Journal of Clinical Child Psychology, 29*, 282–292. doi:10.1207/S15374424jccp2902_13.

Ferdinand, R. F., van der Ende, J., & Verhulst, F. C. (2004). Parent-adolescent disagreement regarding psychopathology in adolescents from the general population as a risk factor for adverse outcome. *Journal of Abnormal Psychology, 113*, 198–206. doi:10.1037/0021-843X.113.2.198.

Funder, D. C. (2009). Persons, behaviors and situations: an agenda for personality psychology in the postwar era. *Journal of Research in Personality, 43*, 120–126. doi:10.1016/j.jrp. 2008.12.041.

Ganzach, Y. (1997). Misleading interaction and curvilinear terms. *Psychological Methods, 2*, 235–247. doi:10.1037/1082-989X.2.3.235.

Goodman, K. L., De Los Reyes, A., & Bradshaw, C. P. (2010). Understanding and using informants' reporting discrepancies of youth victimization: a conceptual model and recommendations for research. *Clinical Child and Family Psychology Review, 13*, 366–383. doi:10.1007/s10567-010-0076-x.

Griffin, D., Murray, S., & Gonzalez, R. (1999). Difference score correlations in relationship research: a conceptual primer. *Personal Relationships, 6*, 505–518. doi:10.1111/j.1475-6811.1999.tb00206.x.

Johns, G. (1981). Difference score measures of organizational behavior variables: a critique. *Organizational Behavior and Human Performance, 27*, 443–463. doi:10.1016/0030-5073(81)90033-7.

Kraemer, H. C., Measelle, J. R., Ablow, J. C., Essex, M. J., Boyce, W. T., & Kupfer, D. J. (2003). A new approach to integrating data from multiple informants in psychiatric assessment and research: mixing and matching contexts and perspectives. *American Journal of Psychiatry, 160*, 1566–1577. doi:10.1176/appi.ajp.160.9.1566.

Laird, R. D., & Marrero, M. D. (2010). Information management and behavior problems: is concealing misbehavior necessarily a sign of trouble? *Journal of Adolescence, 33*, 297–308. doi:10.1016/j.adolescence.2009.05.018.

Laird, R. D., & Marrero, M. D. (2011). Mothers' knowledge of early adolescents' activities following the middle school transition and pubertal maturation. *Journal of Early Adolescence, 31*, 209–233. doi:10.1177/0272431609361202.

Laird, R. D., & Weems, C. F. (2011). The equivalence of regression models using difference scores and models using separate scores for each informant: implications for the study of informant discrepancies. *Psychological Assessment, 23*, 388–397. doi:10.1037/a0021926.

Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: a developmental taxonomy. *Psychological Review, 100*, 674–701. doi:10.1037/0033-295X.100.4.674.

Muthén, L. K., & Muthén, B. O. (2010). *Mplus user's guide* (6th ed.). Los Angeles: Muthén & Muthén.

Nelson, D. A., Hart, C. H., Yang, C., Olsen, J. A., & Jin, S. (2006). Aversive parenting in China: Associations with child physical and relational aggression. *Child Development, 77*, 554–572. doi:10.1111/j.1467-8624.2006.00890.x.

Orpinas, P. (1993). *Skills training and social influences for violence prevention in middle schools: A curriculum evaluation*. Unpublished doctoral dissertation. Houston, TX: University of Texas Health Science Center.

Pelton, J., & Forehand, R. (2001). Discrepancy between mother and child perceptions of their relationship: I. Consequences for adolescents considered within the context of parental divorce. *Journal of Family Violence, 16*, 1–15. doi:10.1023/A:1026527008239.

Petersen, A. C., Crockett, L., Richards, M., & Boxer, A. (1988). A self-report measure of pubertal status: reliability, validity, and initial norms. *Journal of Youth and Adolescence, 17*, 117–133. doi:10.1007/BF01537962.

Racz, S. J., & McMahon, R. J. (2011). The relationship between parental knowledge and monitoring and child and adolescent conduct problems: a 10-year update. *Clinical Child and Family Psychology Review, 14*, 377–398. doi:10.1007/s10567-011-0099-y.

Richters, J. E. (1992). Depressed mothers as informants about their children: a critical review of the evidence for distortion. *Psychological Bulletin, 112*, 485–499. doi:10.1037/0033-2909.112.3.485.

Robin, A. L., & Foster, S. L. (1989). *Negotiating parent-adolescent conflict: A behavioral-family systems approach*. Guilford Press.

Rogosa, D. R., & Willett, J. B. (1983). Demonstrating the reliability of the difference score in the measurement of change. *Journal of Educational Measurement, 20*, 335–343. doi:10.1111/j.1745-3984.1983.tb00211.x.

Schaefer, E. S. (1965). Children's reports of parental behavior: an inventory. *Child Development, 36*, 413–424.

Schludermann, S., & Schludermann, E. (1988). *Questionnaire for children and youth (CRPBI-30)*. Unpublished manuscript, University of Manitoba, Winnipeg.

Sentse, M., & Laird, R. D. (2010). Parent-child relationships and dyadic friendship experiences as predictors of behavior problems in early adolescence. *Journal of Clinical Child and Adolescent Psychology, 39*, 873–884. doi:10.1080/15374416.2010.517160.

Shirtcliff, E. A., Dahl, R. E., & Pollack, S. D. (2009). Pubertal development: correspondence between hormonal and physical development. *Child Development, 80*, 327–337. doi:10.1111/j.1467-8624.2009.01263.x.

Tein, J.-Y., Roosa, M. W., & Michaels, M. (1994). Agreement between parent and child reports on parental behaviors. *Journal of Marriage & The Family, 56*, 341–355. doi:10.2307/353104.