How Did It Work? Who Did It Work for? Mediation in the Context of a Moderated Prevention Effect for Children of Divorce

Jenn-Yun Tein,
Program for Prevention Research, Arizona State University

Irwin N. Sandler,
Program for Prevention Research and Department of Psychology, Arizona State University

David P. MacKinnon,
Department of Psychology, Arizona State University.

Sharlene A. Wolchik
Program for Prevention Research and Department of Psychology, Arizona State University

Abstract

This study presents a reanalysis of data from an effective preventive intervention for children from divorced families (S. A. Wolchik et al., 2000) to test mediation of program effects. The study involved 157 children, age 9–12 years, who were randomly assigned to a parenting program or a literature control condition. Program effects to reduce posttest internalizing problems were mediated through improvement in mother–child relationship quality. Program effects to reduce externalizing problems at posttest and 6 months were mediated through improvement in posttest parental methods of discipline and mother–child relationship quality. The study also describes a new methodology to test mediation of Program × Baseline Status interactions. Analyses demonstrate mediation effects primarily for children who began the program with poorer scores on discipline, mother–child relationship quality, and externalizing problems.

Many prevention programs are based on a theory of the mechanisms that mediate their effects on problem outcomes (Lipsey, 1990; Sandler, Wolchik, MacKinnon, Ayers, & Roosa, 1997). The theory typically proposes that the intervention program affects a proximal variable (e.g., discipline) and that change in that variable leads to change in the problem outcomes (e.g., externalizing problems). Variables that represent the mechanisms by which a program affects a problem outcome are referred to as mediators of the program effects. Methods for analyzing mediators of program effects have advanced rapidly over the past decade (e.g., Holmbeck, 1997; Kraemer, Wilson, Fairburn, & Agras, 2002; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002), and prevention programs have identified mediators of program effects on problem outcomes (e.g., Komro et al., 2001; Spoth, Redmond, & Shin, 1998). However, mediation analysis is complicated when the effects of a program are moderated by another variable (i.e., differ as a function of individuals' scores on another variable). For example, evaluations commonly report that prevention programs

are more beneficial for those with more problems at the start of the program (Brown & Liao, 1999; see also Pacifici, Stoolmiller, & Nelson, 2001; Stoolmiller, Eddy, & Reid, 2000).

In this article, we have two objectives. First, we examine mediators of the effects of the New Beginnings Program (NBP), a preventive intervention for divorced families that found both main effects and Program × Baseline Status (moderated) effects to reduce children's mental health problems (Wolchik et al., 2000). Second, because to our knowledge this is the first article in the literature to report on the analysis of mediation of preventive effects in which the program effects were moderated by baseline status rather than just by main effects (Baron & Kenny, 1986), we discuss the methodology in length as well as the conceptual issues in testing these effects.

NBP: A Theoretically Based Preventive Intervention

The NBP (Wolchik et al., 2000) was designed to change potentially modifiable correlates that, demonstrated by research, were associated with mental health problems for children of divorce. The small theory (Lipsey, 1990) of the intervention is that program-induced change in these variables would lead to (i.e., mediate) program-induced change in children's mental health problems. We assessed whether changes in four variables targeted by a preventive intervention program for custodial mothers (mother program [MP]) mediate the previously reported effects of the MP relative to a self-study literature control (LC) condition[1] (Wolchik et al., 2000) to reduce internalizing and externalizing problems: (a) mother–child relationship quality (e.g., Hetherington et al., 1992), (b) effective discipline (e.g., Forgatch & DeGarmo, 1999), (c) father access to child[2] (e.g., Braver et al., 1993), and (d) interparental conflict (e.g., Grych, Seid, & Fincham, 1992). As described by Wolchik et al. (2000), at posttest and at 6-month follow-up, children with higher baseline externalizing problems benefited more from the MP than did those with lower baseline externalizing problems (i.e., a significant Program × Baseline Status interaction effect). There was also a significant main effect of the program to reduce internalizing problems at posttest. Significant Program × Baseline effects were also found for the following theoretical mediators: mother–child relationship quality, mother's attitude toward father's visitation and father–child relationship, and interparental conflict. The MP had a more beneficial effect for families who had worse baseline scores on each variable. In addition, there were significant main effects for the MP to improve effective parental discipline and behavioral observation measures of attending to and validating child conversation content as compared with the LC.

Theory of Mediation for Prevention Programs in the Context of Moderated Effects

The Program Condition × Baseline Status interaction effects in the evaluation of NBP are consistent with Pillow, Sandler, Braver, Wolchik, and Gersten's (1991) argument that

---

[1]The third condition in the trial was a multicomponent MPCP. This condition was compared with the MP to test additive effects; no significant differences were found between the effects of the two programs on outcome measures.
[2]Although empirical studies have demonstrated that the quality of a father–child relationship rather than father–child contact per se relates to children's adjustment, because the program worked with mothers, we could indirectly target this mediator only through decreasing barriers they might present to contact between father and child.

prevention programs should primarily impact those who are functioning poorly on variables that mediate the impact of the risk factor on outcomes. The analyses presented here test theoretical mechanisms in specific subgroups in which the program affects theoretical mediators and mental health outcomes in a beneficial way. For example, consider the case in which mother–child relationship quality is the hypothesized mediator and posttest externalizing problems are the outcome. One mediational proposition is that for the subgroups low on relationship quality or high on externalizing problems at baseline, improvement in externalizing problems is mediated by improvement in relationship quality. Theoretically, because the NBP targeted multiple mediators, any of the other mediators that were changed by the program (e.g., discipline) might also account for the effects of the program to reduce externalizing problems for those who were high on externalizing problems at baseline.

Understanding of mediation in the context of moderated program effects has important practical implications. Knowledge of the processes by which the program works for specific subgroups enables researchers to make the program more efficient by identifying those who can most benefit from the program and by refining the intervention to focus on those strategies that are designed to change program mediators.

Analysis of Mediation and Moderation in the Context of Moderated Program Effects

The methodology for assessing mediation and moderation has been presented by multiple authors (e.g., Baron & Kenny, 1986; Holmbeck, 1997). MacKinnon and Dwyer (1993), on the basis of the work of Kenny and colleagues (Baron & Kenny, 1986; Judd & Kenny, 1981), presented four criteria for testing mediation of intervention effects: (a) Is there an intervention effect on the mental health outcome? (b) Is there an intervention effect on the mediator? (c) Does the mediator have a significant effect on the outcome variable, when both the intervention effect and the mediator variable are included as predictors of the outcome variable? and (d) Is the mediation effect significant? An additional question is required to assess mediation when there are moderated effects of an intervention program (e.g., Program $\times$ Baseline interactions): For what subgroup is the mediation effect significant? As discussed in the data analysis section, the statistical model for testing this last question needs to include Program Condition $\times$ Baseline Status interaction effects as well as program and baseline main effects. Using these criteria, we reanalyzed the data from Wolchik et al.'s (2000) study to test mediation of the effects of the MP to reduce internalizing and externalizing problems.

Method

Wolchik et al. (2000) provided a detailed description of the participants, sample representativeness, measures, and intervention conditions. Brief descriptions of the participants, measures, and construction of composite scores are provided here.

Participants and Program Conditions

Two hundred and forty divorced families, in which mothers were the primary residential parents of children between the ages of 9 and 12 years, were randomly assigned to one of three conditions: (a) an 11-session MP group ($n = 81$ families), (b) a dual-mother plus child program (MPCP) intervention group (separate 11-session groups for mothers and children; $n = 83$ families), or (c) a self-study LC group ($n = 76$ families), in which mothers and children were each provided a different set of three books about divorce adjustment that were age appropriate (see Wolchick et al., 2000, for the titles and for a fuller description of the procedures used in this condition). Mean age of the interviewed children was 10.4 years ($SD = 1.1$). Of these children, 49% were girls. Mean maternal age was 37.3 years ($SD = 4.8$). The majority of the mothers were Caucasian (88%); the rest were Hispanic (8%), African American (2%), Asian (1%), and other (1%). Of the mothers, 85% had high school education or beyond. On the basis of the Child Behavior Checklist (CBCL) T scores (i.e., T = 67; Achenbach, 1991), 35% of the children had baseline internalizing or externalizing scores above the clinical cutpoint. The mean CBCL T score on internalizing was 58 ($SD = 9.77$, range = 33–83), and the mean CBCL T score on externalizing was 54 ($SD = 9.16$, range = 30–79).

Measures

Mother–Child Relationship Quality—This construct was assessed with a composite of six variables ($a = .77$):[3] mother report on the acceptance and rejection subscales of the Child Report of Parenting Behavior Inventory (CRPBI; Schaefer, 1965), child report of acceptance and rejection on CRPBI, and mother and child report of the open family communication subscale of the Parent–Adolescent Communication Scale (Barnes & Olson, 1982). In addition, two aspects of maternal communication, rated from taped 15-min behavioral interactions between mother and child, were used: attending to the child ($\kappa = .84$) and validating child conversation content ($\kappa = .83$; Griffin & Decker, 1992).

Discipline—A composite of four scales was used to assess this construct ($a = .86$): mother and child reports of the inconsistent discipline subscale of the CRPBI (Schaefer, 1965) and mother report of the ratio of appropriate-to-inappropriate discipline and follow-through on a questionnaire developed by the Oregon Social Learning Center (1991).

Interparental Conflict—A composite of mother and child report on a three-item measure of the frequency subscale of the Children's Perception of Interparental Conflict Scale (Grych et al., 1992) was used ($a = .69$).

Mothers' Attitudes Toward the Noncustodial Father–Child Relationship—This measure assessed mothers' attitudes toward the noncustodial fathers' visitation of the target children and support of the noncustodial father–child relationship (Braver et al., 1993; $a = .85$).

---

[3]The reliability coefficients for all composite scores were computed with the weighted alpha coefficients, weighting by the variance of each of the measures (Lord & Novick, 1968).

Child Externalizing Problems—A composite (a = .91) of mother report on the externalizing subscale of the CBCL (Achenbach, 1991) and child report on the Divorce Adjustment Project Hostility Scale (see Wolchik et al., 2000) was used. Teacher report consisted of the acting-out subscale of the Teacher–Child Rating Scale (Hightower, 1987; a = .90). Teacher data were analyzed separately to have an indicator of child mental health problems from an informant who was not aware of the child's involvement in the program versus LC condition.

Child Internalizing Problems—A composite (a = .90) of mother report on the internalizing subscale of the CBCL (Achenbach, 1991) and child report on the Children's Manifest Anxiety Scale–Revised (Reynolds & Richmond, 1978) and the Child Depression Inventory (Kovacs, 1981) was used. Teacher report consisted of the shy–anxious subscale of the Teacher–Child Rating Scale (Hightower, 1987; a = .82).

Statistical Analysis Strategy

Mediation Models—Structural equation modeling (SEM), specifically path analysis, was used to test each of the mediational models. A general mediation model was derived from the theory that the intervention affects each mediator and that each mediator in turn affects externalizing and internalizing problems. The change in the mediator or the problem outcome was represented by the postintervention variable (T2), controlling for the stability effect (i.e., baseline status [T1]). For the prospective model, changes in mediators at T2 were hypothesized to lead to changes in problem outcomes at 6-month follow-up (T3), satisfying the condition of temporal precedence and providing a stronger test that program-induced change in mediators caused change in the problem outcomes. Figure 1 shows the mediation model in a two time-point longitudinal study (see Sandler et al., 1997) in which the product of a and b is the indirect or mediation program effect; c is the direct program effect; and d, e, and f are the effects of the control variables. These paths illustrate the basic model in which there are only intervention main effects on the mediator and outcome variables. However, as discussed earlier, in Wolchik et al. (2000) the intervention effects on some of the putative mediators and problem outcomes were conditioned by baseline status on those variables. There are three possible forms of such mediation models in which there are moderated effects of the program: (a) Model I: a Program × Baseline Mediator interaction (i.e., basic model + path g), (b) Model II: a Program × Baseline Mental Health Problem Outcome interaction (i.e., basic model + paths h and i), and (c) Model III: both Program × Baseline Mediator and Program × Baseline Mental Health Problem Outcome interactions (i.e., basic model + paths g, h, and i). We tested either Model I, II, or III using SEM, depending on the findings for each variable in Wolchik et al. (2000).

Assessing the Direction of Moderated Effects—When there is a moderated effect, the relation between the independent and outcome variables depends on the value of the moderator. In multiple regression analyses, it is common to assess the direction of the effects of the independent variable at different levels of the moderator by testing the simple slope of the effect of the predictor on the outcome at different levels of the moderator (e.g., one standard deviation below [−1SD] and one SD above [+1SD] the mean; see Aiken & West, 1991). For example, in Wolchik et al. (2000), the program effect on improving mother–child

relationship quality depended on the mother–child relationship quality at the start of the program. Plots of the regression lines at $+1SD$ and $-1SD$ of mother–child relationship quality illustrate the program effects at high and low baseline levels of mother–child relationship quality. We adapted Aiken and West's (1991) procedures of probing simple regression lines to test the direction of the effects in simple mediation structural equation models when there were Program × Baseline Status interactions with either mediator, outcome, or both variables (Mediation Models I, II, or III, given moderation, see Figure 1). The following is an example of the steps for testing the simple mediation effect within the SEM framework using the mediation effect of T2 mother–child relationship quality to T2 internalizing problems.

Step 1: Decide which of the three mediation models (given moderation) is appropriate and create data sets for the SEM.: Wolchik et al. (2000) found that there were significant Program × Baseline Status interactions for T2 mother–child relationship quality but a main effect only on T2 internalizing problems. As a result, Model I is used for testing the mediation model and the simple mediation effect.

Step 2: Model at the mean (original model).: Center the T1 mother–child relationship quality variable (i.e., T1 mother–child relationship quality, $M = 0$) and create the Program × T1 Mother–Child Relationship Quality interaction variable:

$$\begin{aligned}
&\text{T1 mother−child relationship centered at } M \\
&= \ (\text{T1 mother − child relationship}) \\
&\quad - \ (\ M \text{ of T1 mother − child relationship});
\end{aligned}$$

$$\begin{aligned}
\text{Interaction} \ = \ &(\text{T1 Mother − Child Relationship Centered at } M) \\
&\times \ (\text{Program Condition}).
\end{aligned}$$

Run the SEM (Model I) using the newly centered mediator and interaction variables. Step 2 tests the original model at the mean level of T1 mother–child relationship to assess whether the effects of the program are mediated through the mother–child relationship variable. If path b is significant and the Program × Quality of Mother–Child Relationship interaction term (i.e., path g) is significant, post hoc evaluations of simple mediation effects are conducted at $-1SD$ and $+1SD$ values of T1 mother–child relationship following Steps 3 and 4. As shown in Table 1, the a and b paths and the interaction terms are significant.

Step 3: Model at 1SD below the mean.: Create a new Program × T1 Mother–Child Relationship Quality interaction variable so that the zero point corresponds to $1SD$ below the mean:

$$\begin{aligned}
&\text{Rescale T1 mother−child relationship} \\
&= \ (\text{T1 mother − child relationship centered at } M) \\
&\quad - \ (\ -1SD \text{ of T1 mother − child relationship});
\end{aligned}$$

$$\text{Interaction} = (\text{Rescaled T1 Mother} - \text{Child Relationship Quality}) \times (\text{Program Condition}).$$

Run the SEM (Model I) using the rescaled mother–child relationship quality and newly created interaction variable. As shown in Table 1, at $-1SD$ (low mother–child relationship quality) the a and b paths are both significant.

Step 4: Model at 1SD above the mean.: This step is identical to Step 3 but it rescales the T1 mother–child relationship quality variable so that the zero point corresponds to $1SD$ above the mean (i.e., [T1 mediator centered at mean] – [+$1SD$ of T1 mediator]) and uses the rescaled mother–child relationship quality and newly created interaction variable in the SEM (Model I). As shown in Table 1, at +$1SD$ (high mother–child relationship quality) neither the a nor b path is significant.

Using the results of the three SEMs, we identify the program effect at the mean, +$1SD$, and $-1SD$ of the T1 mother–child relationship quality.[4] In SEM, as in multiple regression analyses, the regression weight stands for the unique relation of the specific independent variable and the dependent variable, controlling for other variables (i.e., at zero for the other variables). Therefore, the path a from Step 2 is the simple path coefficient from the program condition to the T2 mother–child relationship quality at the mean of T1 mother–child relationship quality. The new path a from the program condition to T2 mother–child relationship quality, for the model from Steps 3 or 4, is the desired simple path coefficient at $-1SD$ or +$1SD$ of the mean of T1 mother–child relationship quality (i.e., the new zero point of T1 mother–child relationship quality has shifted to $-1SD$ or +$1SD$ from the mean). The product of a and b is the value for the simple mediation effect for the model at the mean, +$1SD$, or $-1SD$ of the T1 mother–child relationship quality.[5] The significance of the mediation effect, ab, is tested against its own standard error ($ab_{-1SD} / se_{ab \text{ at } -1SD}$ or $ab_{+1SD} / se_{ab \text{ at } +1SD}$).[6] Similar steps apply to the model when there is a significant Program × Baseline Mental Health Problem Outcome interaction (Model II). When there are significant interactions of the program condition with both baseline mediator and baseline mental health problem outcome measures, both the T1 mediator and outcome measures need to be rescaled and SEMs are conducted for low ($-1SD$) mediator and high (+$1SD$) outcome, low ($-1SD$) mediator and low ($-1SD$) outcome, high (+$1SD$) mediator and high (+$1SD$) outcome, and high (+$1SD$) mediator and low ($-1SD$) outcome (Model III).

Results

We conducted analyses of mediation for each significant main effect and Program × Baseline Status interaction effect of the MP as contrasted with the LC on mental health

---

[4]SEM at the mean of the moderator variable is the original model and shows the average program effects. Simple mediation models at +$1SD$ and $-1SD$ of the moderator variables, which better illustrate pictures of the program effects at high and low baseline levels, are the focus of the discussion.

[5]The value of b is assumed to be the same across the mediated moderation models.

[6]The standard error can be calculated as $se_{ab} = \sqrt{(a^2)(se_b^2) + (b^2)(se_a^2)}$ (MacKinnon & Dwyer, 1993; Sobel, 1982).

problem outcome variables (Wolchik et al., 2000) using SEM with maximum likelihood estimation.[7]

Posttest

Two time-point cross-lag models were used to test mediation of the program effects on posttest mental health problems by each of the significant posttest mediator variables. Wolchik et al. (2000) reported a main effect of the program to reduce internalizing problems and a Program × Baseline interaction effect on externalizing problems. There were six significant program effects on putative mediators at posttest: Main effects occurred for attending to child's conversation, validating of child's conversation content, and effective discipline, and there were Program × Baseline interaction effects for mother–child relationship quality, mother's attitude toward father–child relationship, and interparental conflict.

As noted earlier, different SEMs were tested depending on the findings from Wolchik et al. (2000). Table 1 summarizes the statistics for models that had significant mediation effects: (a) the program condition to the mediator variable, (b) the mediator variable to the outcome variable, (c) the direct program effect to the outcome variable, (d) the path coefficients for the Program × Baseline Mediator interaction or the Program × Baseline Outcome interaction that were significant, (e) the z statistics for the significance of the mediation effect ($z_{ab} = ab / se_{ab}$), and (f) the chi-square, degree of freedom, and comparative fit index (CFI) for model fit.

Three of the 12 tests found significant mediation of program effects on the posttest mental health problems (see Table 1). As discussed in the illustrative analysis of the direction of moderated effects above in the section titled "Assessing the Direction of Moderated Effects," the model testing T2 mother–child relationship quality as a mediator of the program effect on T2 internalizing problems follows the pattern of Model I, $\chi^2(2, N = 154) = 4.71$, $p = .09$, CFI = .99. As shown in Table 1, there was also a significant T1 Mother–Child Relationship Quality × Program interaction effect on T2 mother–child relationship quality. As illustrated earlier, the evaluation of the simple mediation effect of mother–child relationship quality found that T2 mother–child relationship quality mediated program effects on T2 internalizing problems for children from families that had low but not high levels of T1 mother–child relationship quality. The mediation model for T2 mother–child relationship quality to T2 externalizing problems was conducted on the basis of Model III, $\chi^2(2, N = 154) = 6.49$, $p = .04$, CFI = .99, in which there were significant Program × Baseline interactions on both the mediator and the mental health problem variables ($\beta = -.13$, $p < .05$; $\beta = -.12$, $p < .05$, respectively). The findings of the post hoc simple mediation effects indicated that for children with low T1 mother–child relationship quality and high T1 externalizing problems, mother–child relationship quality mediated the program effects on T2 externalizing problems. In addition, the program had a direct effect on externalizing

---

[7]The structural equation model computed with maximum likelihood (ML) estimation assumes multivariate normality among the variables. To account for the possible biasing effects of nonnormality, we also conducted the Satorra–Bentler scaled test statistics using EQS, which provide robust statistics to adjust for nonnormality (Bentler, 1995). Results from the robust statistics were nearly identical to those from the standard ML analysis; significance of the individual parameters remained unchanged. These results suggest that nonnormality of the variables was not likely to substantially bias the primary findings.

problems. For children with low T1 mother–child relationship quality and low T1 externalizing problems, there was a significant mediation effect from the program condition to T2 externalizing problems. For children with high T1 mother–child relationship quality and high T1 externalizing problems, the program had a direct effect on externalizing problems that was not mediated by mother–child relationship quality. For children with high T1 mother–child relationship quality and low T1 externalizing problems, there was no significant program effect on T2 externalizing problems.

The model for the mediation effect of T2 discipline to T2 externalizing problems was tested under Model II, $\chi^2(1, N = 154) = 1.07$, $p = .30$, CFI = 1.00. The interaction of Program Condition × T1 Externalizing Problems had a significant effect on T2 Externalizing Problems ($\beta = -.11$, $p < .05$), indicating that the program effect on the proximal variable T2 discipline might depend on baseline levels of externalizing problems. Therefore, the effect of T2 discipline as a mediator of the program effect on T2 externalizing at both $+1SD$ and $-1SD$ values of T1 externalizing problems was tested. The results of post hoc simple effect models indicated that for children with high T1 externalizing problems, program effects on T2 effective discipline were a significant mediator of the effects of the program on T2 externalizing problems. In addition to the mediation effect, the program also had a direct effect on T2 externalizing problems. No program direct or mediated effects were found for children with low baseline externalizing problems.

None of the other putative mediators satisfied the criteria of having an effect on T2 internalizing problems or externalizing problems (i.e., path b). Thus, they were not tested as mediators of program effects on these outcomes.

Six-Month Follow-Up

At 6-month follow-up (T3), there were Program × Baseline interaction effects on both the composite (i.e., mother and child report) and teacher report measures of externalizing problems. As shown in Table 1, we tested whether these program effects were mediated through the significant program effects on the six mediator variables at immediate posttest, and found significant mediation effects for T2 mother–child relationship and T2 effective discipline on T3 composite externalizing problem measure.

The program effect on the T3 composite externalizing problem measure was mediated by a program effect on T2 mother–child relationship quality, $\chi^2(2, N = 132) = 0.83$, $p = .66$, CFI = 1.00, (i.e., Model III). As shown in Table 1, the interaction of Program × T1 Mother–Child Relationship Quality had a significant negative effect on T2 mother–child relationship quality ($\beta = -.12$, $p < .05$), and the interaction of Program Condition × T1 Externalizing Problems also had a significant negative effect on T3 externalizing problems ($\beta = -.15$, $p < .05$). Similar to the findings of the posttest mediation evaluation, the post hoc simple effect modeling indicated that mother–child relationship quality at T2 mediated the effects of the program on T3 externalizing problems for children with low values of T1 mother–child relationship quality and high T1 externalizing problems. There was also a significant mediation effect for T2 mother–child relationship quality for children with both low values of T1 mother–child relationship quality and low T1 externalizing problems. Beyond the

mediated effect, there was also a significant direct program effect on T3 externalizing problems for children with high T1 externalizing problems.

The model testing T2 discipline as a mediator of the program effect on T3 externalizing problems also had a good fit, $\chi^2(1, N = 132) = 0.38$, $p = .54$, CFI = 1.00 (i.e., Model II). There was a significant program effect on T2 effective discipline, which in turn had a negative relation to T3 externalizing problems. The interaction of Program Condition × T1 Externalizing Problems had a significant effect on T3 Externalizing Problems ($\beta = -.14$, $p < .05$). The results of the post hoc simple effect modeling indicated that at high T1 values of externalizing problems, in addition to the direct effect, the program had a mediation effect on T3 externalizing problems through T2 discipline. The models predicting teacher report of externalizing problems did not show evidence of significant mediation.

Discussion

The most important substantial findings from this study are to identify the subgroups for which the NBP reduced internalizing and externalizing problems and to identify the mediators that account for those effects. The effects of the program to reduce posttest internalizing problems occurred only for those who had low baseline mother–child relationship quality, and this effect was fully mediated by improvement in mother–child relationship quality. Reduction of externalizing problems was mediated by both mother child–relationship quality and discipline. For children who were low on mother–child relationship quality at baseline, the program reduced externalizing problems at posttest and 6-month follow-up by improving mother–child relationship quality. For children who were high on baseline externalizing problems, the program effect to reduce externalizing problems was also partially mediated through improving effective discipline.

The methodological contribution of the study is to our knowledge the first illustration of a methodology for testing mediation of program effects when there is a moderator interaction involving baseline status prior to prevention. In addition, the study has numerous methodological strengths including random assignment to conditions, minimal attrition across waves, and use of multiple measures and multiple reporters to assess variables. However, one important limitation is the underrepresentation of ethnic minorities. Latinos and African Americans constitute 12.3% and 12.5% of the U.S. population, respectively (U.S. Census Bureau, 2000), and the divorce rate of these ethnic minorities is comparable with (Latinos) or higher (African Americans) than that of European Americans (Bumpass, Martin, & Sweet, 1991). The testing of prevention programs for ethnic minority divorced families is an important direction for future research. A second limitation is that mediation of program effects at T2 was assessed simultaneously with the outcomes. Although this does not satisfy the condition that the mediator temporally precede the outcome (Kraemer et al., 2002), the analyses are a useful probing of the a priori theoretical model, which the program was based on, and are similar to other tests of mediation of program effects in the literature (Huey, Henggeler, Brondino, & Pickrel, 2000; Johnson et al., 2001). However, the possibility that the causal direction of the effects at T2 may be reversed must be acknowledged (i.e., that program-induced improvements in mental health problems may lead

to improvements in parenting). Similarly, other models may explain observed relations among variables as well as the model tested (MacCallum & Austin, 2000).

The findings for the models in which there was a time lag between mediators (assessed at T2) and externalizing problems (assessed at T3) provide support for the relations in the theory underlying the program. The theory on which the NBP was based specified causal relations between the putative mediators and mental health problems. Although this theory was based on findings of significant correlations between these variables, the nonexperimental nature of past research allows multiple plausible explanations of these relations (Rutter, Pickles, Murray, & Eaves, 2001). In the present study, the random assignment of families to the program and control conditions makes it unlikely that a third variable accounts for the effect of experimentally induced change in parenting or mental health problems. Furthermore, the time lag between the T2 mediator and the T3 outcomes strengthens the inference that the experimentally induced change in parenting influenced improvements in externalizing problems. It is still true, however, that the mediation results presented here, even in the time-lagged case, do not establish a causal relationship between the mediators at T2 and the mental health outcomes at T3 (Holland, 1988; Pearl, 2000). As described in Holland (1988), the randomization at baseline does not eliminate the possibility of confounding influences that intervene between the T2 mediator and the T3 outcome. In spite of this limitation, results such as those reported here are an important first step toward demonstrating that improvements in parenting lead to subsequent improvements in externalizing problems.

How can the absence of mediation effects for interparental conflict and mothers' attitudes toward father visitation be explained? It is possible that program effects on these variables were not of sufficient magnitude to affect mental health problems. For example, the Program × Baseline interaction effect on interparental conflict was relatively small, and Wolchik et al. (2000) noted that there were few participants in the range of the baseline score of interparental conflict beyond which the program and control groups differed at posttest. Thus, although the effect is significant, it has little practical implication for explaining differences between participants in this study. Also, the measurement approach may not have tapped the linkages through which these constructs affect mental health outcomes. For example, mothers' attitudes toward father visitation might have an indirect effect through an impact on unmeasured variables that directly impact children's mental health outcomes such as father–child relationship quality.

The identification of mediators and moderators of program effects also has implications for program dissemination. One issue in dissemination concerns modification or adaptation of program components. Price and Lorion (1989) proposed that some program elements be considered core and not open to change whereas others be identified as appropriate for modification or adaptation by adopting agencies. The results of the mediation analyses indicated that the aspects of the NBP that are designed to improve mother–child relationship quality and effective discipline should be considered core elements to be delivered with fidelity in disseminated versions of the NBP. A second issue in dissemination concerns recruitment. The current results identify subgroups that benefited from the program and thus should be recruited to participate. For example, children in divorced families who scored

high on externalizing problems and low on mother–child relationship quality received the most benefit from participation and thus should be targeted for recruitment.

Acknowledgments

References

Achenbach TM (1991). Manual for the Child Behavior Checklist/4–18 and 1991 Profile. Burlington: University of Vermont, Department of Psychiatry.

Aiken LS, & West SG (1991). Multiple regression: Testing and interpreting interactions. Newbury Park, CA: Sage.

Barnes H, & Olson D (1982). Parent–adolescent communication. In Olson D, McCubbin H, Barnes H, Larsen A, Muxen M, & Wilson M (Eds.), Family inventories (pp. 33–49). St. Paul, MN: Family Social Sciences.

Baron RM, & Kenny DA (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173–1182. [PubMed: 3806354]

Bentler PM (1995). EQS structural equations program manual. Encino, CA: Multivariate Software, Inc.

Braver SL, Wolchik SA, Sandler IN, Sheets VL, Fogas B, & Bay RC (1993). A longitudinal study of noncustodial parents: Parents without children. Journal of Family Psychology, 7, 9–23.

Brown CH, & Liao J (1999). Principles for designing randomized prevention trials in mental health: An emerging developmental epidemiology paradigm. American Journal of Community Psychology, 27, 673–710. [PubMed: 10676544]

Bumpass LL, Martin TC, & Sweet JA (1991). The impact of family background and early marital factors on marital disruption. Journal of Family Issues, 12, 22–42. [PubMed: 12316638]

Forgatch MS, & DeGarmo DS (1999). Parenting through change: An effective prevention program for single mothers. Journal of Consulting and Clinical Psychology, 67, 711–724. [PubMed: 10535238]

Griffin WA, & Decker A (1992). New beginnings coding system (Tech Rep. No. 92–01). Tempe: Arizona State University, Prevention Intervention Research Center.

Grych JH, Seid M, & Fincham FD (1992). Assessing marital conflict from the child's perspective: The children's perception of interparental conflict scale. Child Development, 63, 558–572. [PubMed: 1600822]

Hetherington EM, Clingempeel WG, Anderson ER, Deal JE, Stanley-Hagan M, Hollier EA, & Lindner MS (1992). Coping with marital transitions: A family systems perspective. Monographs of the Society for Research in Child Development, 57 (2–3, Serial No. 227).

Hightower AD (1987). Primary mental health project Teacher-Child Rating Scale (T-CRS) guidelines. Rochester, NY: University of Rochester.

Holland PW (1988). Causal inference, path analysis, and recursive structural equation models. In Clogg C (Ed.), Sociological methodology (pp. 449–484). Washington, DC: American Sociological Association.

Holmbeck GN (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. Journal of Consulting and Clinical Psychology, 65, 599–610. [PubMed: 9256561]

Huey SJ, Henggeler SW, Brondino MJ, & Pickrel SG (2000). Mechanisms of change in multisystemic therapy: Reducing delinquent behavior through therapist adherence and improved family and peer functioning. Journal of Consulting and Clinical Psychology, 68, 451–467. [PubMed: 10883562]

Johnson JG, Alloy LB, Panzarella C, Metalsky GI, Rabkin JG, Williams BW, & Abramson LY (2001). Hopelessness as a mediator of the association between social support and depressive symptoms: Findings of a study of men with HIV. Journal of Consulting and Clinical Psychology, 69, 1056–1060. [PubMed: 11777109]

Judd CM, & Kenny DA (1981). Process analysis: Estimating mediation in treatment evaluations. Evaluation Review, 5, 602–619.

Komro KA, Perry CL, Williams MH, Stigler MH, Farbakhsh K, & Veblen-Mortenson S (2001). How did Project Northland reduce alcohol use among young adolescents? Analysis of mediating variables. Health Education Research: Theory and Practice, 16, 59–70.

Kovacs M (1981). Rating scales to assess depression in school-aged children. Acta Pacedopsychiatrica, 46, 305–315.

Kraemer HC, Wilson T, Fairburn CG, & Agras WS (2002). Mediators and moderators of treatment effects in randomized clinical trials. Archives of General Psychiatry, 59, 877–883. [PubMed: 12365874]

Lipsey MW (1990). Theory as method: Small theories of treatments. In Sechrest L, Perrin E, & Bunker J (Eds.), Research methodology: Strengthening causal interpretations of nonexperimental data (DHHS Publication No. 90–3454, pp. 33–51). Washington, DC: U.S. Department of Health and Human Services, Agency for Health Care Policy and Research.

Lord FM, & Novick MR (1968). Statistical theories of mental test scoring. Reading, MA: Addison Wesley.

MacCallum RC, & Austin JT (2000). Applications of structural equation modeling in psychological research. Annual Review of Psychology, 51, 201–226.

MacKinnon DP, & Dwyer JH (1993). Estimating mediated effects in prevention studies. Evaluation Review, 17, 144–158.

MacKinnon DP, Lockwood CM, Hoffman JM, West SG, & Sheets V (2002). A comparison of methods to test mediation and other intervening variable effects. Psychological Methods, 7, 83–104. [PubMed: 11928892]

Oregon Social Learning Center. (1991). LIFT parent interview. Unpublished manual, Eugene, OR.

Pacifici C, Stoolmiller M, & Nelson C (2001). Evaluating a prevention program for teenagers on sexual coercion: A differential effectiveness approach. Journal of Consulting and Clinical Psychology, 69, 352–359.

Pearl J (2000). Causality: Models, reasoning, and inference. New York: Cambridge University Press.

Pillow DR, Sandler IN, Braver SL, Wolchik SA, & Gersten JC (1991). Theory-based screening for prevention: Focusing on mediational processes in children of divorce. American Journal of Community Psychology, 19, 809–836. [PubMed: 1793090]

Price RH, & Lorion RP (1989). Prevention programming as organizational reinvention: From research to implementation. In Schaffer D, Philips I, & Enzer N (Eds.), Prevention of mental disorders, alcohol and other drug use in children and adolescents (DHHS Publication No. ADM 90–1646, pp. 97–123). Washington, DC: Office of Substance Abuse Prevention.

Reynolds CR, & Richmond B (1978). What I think and feel: A revised measure of children's manifest anxiety. Journal of Consulting and Clinical Psychology, 6, 271–280.

Rutter M, Pickles A, Murray R, & Eaves L (2001). Testing hypotheses on specific environmental causal effects on behavior. Psychological Bulletin, 127, 291–324. [PubMed: 11393298]

Sandler IN, Wolchik SA, MacKinnon D, Ayers TS, & Roosa MW (1997). Developing linkages between theory and intervention in stress and coping processes. In Wolchik SA & Sandler IN (Eds.), Handbook of children's coping with life stressors: Linking theory, research and interventions (pp. 3–40). New York: Plenum Press.

Schaefer ES (1965). Children's report of parental behavior: An inventory. Child Development, 36, 413–424. [PubMed: 14300862]

Sobel ME (1982). Asymptotic confidence intervals for indirect effects in structure equation models. In Leinhardt S (Ed.), Social methodology (pp. 290–312). San Francisco: Jossey-Bass.

Spoth R, Redmond C, & Shin C (1998). Direct and indirect latent variable parenting outcomes of two universal family-focused preventive interventions: Extending a public-health research base. Journal of Consulting and Clinical Psychology, 66, 385–399. [PubMed: 9583342]

Stoolmiller M, Eddy JM, & Reid JB (2000). Detecting and describing preventive intervention effects in a universal school-based randomized trial targeting delinquent and violent behavior. Journal of Consulting and Clinical Psychology, 68, 296–306. [PubMed: 10780130]

U.S. Census Bureau. (2000). United States Census File 1 (SF-1). Retrieved September 18, 2002, from http://www.census.gov/Press-Releas/www/2001/sumfile1.html

Wolchik SA, West SG, Sandler IN, Tein J-Y, Coatsworth D, Lengua L, et al. (2000). An experimental evaluation of theory-based mother and mother–child programs for children of divorce. Journal of Consulting and Clinical Psychology, 68, 843–856. [PubMed: 11068970]
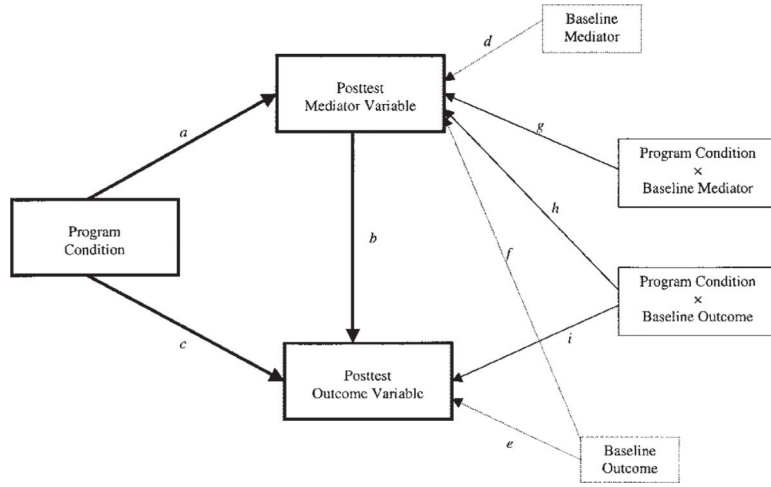
Figure 1.
Basic model: only intervention main effects on the mediator and outcome variables (i.e., paths *a, b, c, d, e,* and *f*); Mediated (given moderation) Model I: a Program Condition × Baseline Mediator interaction (i.e., basic model plus path *g*); Mediated (given moderation) Model II: a Program Condition × Baseline Outcome interaction (i.e., basic model plus paths *h* and *i*); Mediated (give moderation) Model III: both Program Condition × Baseline Mediator and Program Condition × Baseline Outcome interactions (i.e., basic model plus paths *g, h,* and *i*). All of the independent variables are correlated in each of the models.

Table 1

Summary of the Mediation Effects—Posttest Cross-Lag and Prospective Effect Mediation Models

Moderator variable	Outcome variable	a	b	c	Program × Med[b]	Program × Out[b]	z_{ab}[a]	χ^2[b]	df[b]	CFI[b]
				Posttest cross-lag mediation evaluation						
T2 mother–child relationship[c]	T2 internalizing problem	.18**	−.16**	−.09	−.14*			4.71	2	.99
Low mother–child relationship		.30**	−.16*	−.09			−2.28			
High mother–child relationship		.05	−.16	−.09			ns			
T2 mother–child relationship[d]	T2 externalizing problem	.20**	−.24**	−.15*	−.13*	−.12*		6.49	2	.99
Low mother–child relationship and high externalizing problems		.39**	−.24**	−.29**			−3.14			
Low mother–child relationship and low externalizing problems		.25**	−.24**	−.01			−2.04			
High mother–child relationship and high externalizing problems		.11	−.24**	−.29**			ns			
High mother–child relationship and low externalizing problems		.01	−.24**	−.01			ns			
T2 effective discipline[d]	T2 externalizing problem	.21**	−.17**	−.15**		−.11*		1.07	1	1.00
Low externalizing problems		.13	−.17**	−.03			ns			
High externalizing problems		.28**	−.17**	−.17**		−2.11				
				Posttest cross-lag mediation evaluation						
T2 mother–child relationship[c]	T3 externalizing problem	.22**	−.15*	−.14**	−.12*	−.15*		.83	2	1.00
Low mother–child relationship and high externalizing problems		.40**	−.15*	−.31**			−1.81			
Low mother–child relationship and low externalizing problems		.25*	−.15*	.02			−1.66			
High mother–child relationship and high externalizing problems		.17	−.15*	−.31**			ns			
High mother–child relationship and low externalizing problems		.03	−.15*	.02			ns			
T2 effective discipline[d]	T3 externalizing problem	.24**	−.14*	−.13		−.14*		.38	1	1.00
Low externalizing problems		.17	−.14*	−.02			ns			
High externalizing problems		.30**	−.14**	−.29**		−1.70				

Note. Med = mediation; TI = baseline status; Out = outcome; CFI = comparative fit index; T2 = postintervention variable; T3 = 6-month follow-up.

[a] Because of the interaction of Program × Baseline Level, the significant test of the mediation was conducted only for simple structural equation models at $+1SD$ and $-1SD$ of the moderator variable.

[b] The chi-square, *df* CFI, and interaction effects were presented only for the original model. These model fits were the same across simple structural models.

[c] Following the pattern of Model III.

[d] Following the pattern of Model II.

[*] $p < .05$

[**] $p < .01$.