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Test of “Facilitation” vs. “Proximal Process” Moderator Models for the Effects of Multisystemic Therapy on Adolescents with Severe Conduct Problem

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Abstract

The present study identified moderators of Multisystemic Therapy’s (MST) effects on adolescent conduct problems, considering “*facilitation*” and “*proximal process*” moderation models. The sample included 164 adolescents (mean age=14.6 years; 83% male) randomly assigned to receive MST or services as usual; parent, youth, and teacher reports of adolescent functioning were obtained. A number of significant moderators were identified. Proximal process moderation patterns were identified (e.g., families with parents with lower levels of adaptive child discipline skills gained more from MST), but the majority of significant interactions showed a facilitation moderation pattern with, for instance, higher levels of adaptive functioning in families and parents appearing to facilitate MST (i.e., greater benefits from MST were found for these families). This facilitation pattern may reflect such families being more capable of and/or more motivated to use the resources provided by MST. It is suggested that factors consistently identified as facilitation moderators may serve as useful foci for MST’s strength-based levers of change approach. Other implications of these findings for individualized treatment also are discussed.

Keywords

MST; Moderators of treatment effects; Statistical interactions; Facilitation; Proximal process

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Conduct problems are one of the most significant mental health problems among young people. Estimates of the prevalence of Conduct Disorder range up to 10%, and conduct problems exact high costs to society (Lahey, 2008). One intervention for adolescent conduct problems that has accumulated evidence for its efficacy is Multisystemic Therapy (MST; Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 2009). MST is a family-focused, home-based intervention model that treats severe antisocial behavior in youth, focusing on multiple factors linked to antisocial behavior. MST's theory of behavior change is based on Bronfenbrenner's (1979) theory of social ecology. It views human behavior as multi-determined, influenced by a range of social systems such as the family, school, peers, etc. Interpersonal interaction is reciprocal, with parents influencing the child but the child also influencing the parents. To address the multi-determined risk factors for adolescent antisocial behavior, MST is delivered in an intensive, individualized manner to meet each family's unique needs. Target domains for intervention can involve family functioning, child and parent psychopathology, peer relational problems, etc. (Henggeler et al., 2009).

Although MST has received empirical support as an efficacious treatment for conduct problems (e.g., Curtis, Ronan, & Borduin, 2004), there has been notable variability in participants' response to treatment, both within and across studies (cf., Borduin et al., 1995; Timmons-Mitchell, Kishna, Bender, & Mitchell, 2006). Thus, identification of statistical moderators (i.e., factors that predict differential response to treatment) that can help to explain this variability in treatment response will be an important step in the evaluation of programs such as MST (La Greca, Silverman, & Lochman, 2009). Assessment of moderators allows for identification of for whom this relatively expensive program would be most justified (i.e., for whom it would be more or less effective), and for whom the program should be modified to increase its effectiveness (Manders, Dekovic, Asscher, van der Laan, & Prins, 2013). To date, few consistent moderators of MST efficacy have been identified, with the effects of MST on adolescent conduct problems generally found to not vary significantly as a function of youth age, sex, or race (e.g., Asscher et al., 2013; Borduin et al., 1995; Schaeffer, 2001). Using the same sample as Asscher et al. (2013), Manders et al. (2013) did find that MST was significantly more effective for adolescents with lower (as compared to higher) levels of callous/unemotional or narcissistic traits.

The number of studies and range of potential moderators of MST efficacy that have been investigated is relatively limited, but the literature focusing on behavioral parent training (BPT) interventions more broadly is larger. However, in contrast to MST's focus on adolescents, most BPT studies have focused on younger children, often elementary or pre-school age (e.g., Beauchaine, Webster-Stratton, & Reid, 2005; Lundahl, Risser, & Lovejoy, 2006). Because of developmental effects (e.g., specific parenting behaviors adaptive at younger developmental phases may not be adaptive at older developmental phases; peer groups become more influential in adolescence; Dishion, Piehler, & Myers, 2008; Steinberg & Silk, 2002) and because MST's focus extends beyond the parents per se, to the parents as individuals (e.g., with their own mental health problems that must be addressed), to the school, the neighborhood, etc., the results of BPT research should be applied with caution to MST. Nonetheless, the broader BPT literature may provide some useful suggestions for potential moderation of MST treatment effects. Within this broader literature, child

demographic characteristics (e.g., age, gender) typically have been found not to significantly moderate parent training interventions' effects on child conduct problems (e.g., Nock, 2003). Some studies have found that baseline level of child conduct problems moderates treatment response, but the direction of these effects has been inconsistent (cf., CPPRG, 2011; Nock, 2003; Webster-Stratton & Hammond, 1990). Meta-analytic reviews of parent training interventions for treatment of conduct problems (e.g., Lundahl et al., 2006) suggest that economic disadvantage (i.e., low family income, low parent education/occupation) moderates treatment response, with youth who are not disadvantaged benefitting more from treatment.

In the present study, our evaluation of potential moderators of MST was structured following what might be called a *moderator mechanisms of causal influence model*, with this broad model involving two patterns: "Facilitation" and "Proximal Process" moderation. Within the depression literature, Cheavens, Strunk, Lazarus, and Goldstein (2012) have suggested two models for treatment individualization to maximize treatment outcomes: A capitalization approach wherein clients benefit more when the treatment is focused on relative behavioral, cognitive, etc. strengths, and a compensation approach wherein clients benefit more when the treatment is focused on compensating for their relative deficits. In regard to moderation (as opposed to treatment individualization), a "Facilitation" moderator model may be a more appropriate conceptualization than a capitalization model, one that in essence posits that treatment will be more effective when a family or client possesses strengths that facilitate their use or the therapist's implementation of the treatment. For instance, in MST, adolescents in families with higher levels of positive parent-adolescent relationships may be less likely to automatically reject parents' disciplinary behavior than adolescents in families with lower levels of positive parent-adolescent relationships (Henggeler et al., 2009); thus, the positive parent-adolescent relationship would facilitate the implementation, and success, of the parent intervention.

A "Proximal Process" moderator model posits that treatment will be more effective when the maladaptive processes that are relatively proximal to the development or maintenance of a particular family's mental health problems are targets that the treatment has the capacity to modify. Operationally, if a family is high on a process that the intervention specifically targets (because that process is hypothesized to cause or perpetuate the mental health problem), then that family should respond better to treatment because in essence the family is appropriate for this treatment program. Conversely, a family that is low on the process targeted by the treatment may respond less well to treatment, because being low on a proximal process would suggest that other factors, not necessarily targeted specifically by the treatment, may be perpetuating the family's mental health problems.

For instance, in MST, parenting skills deficits are believed to be part of the proximal causes and perpetuating factors (e.g., lack of reinforcement of positive behavior; lack of monitoring and appropriate punishment for undesired adolescent behavior) of adolescent conduct problems. According to the Proximal Process moderation model, families that have high levels of deficits in parenting skills (or low levels of adaptive parenting skills) will respond better to treatment because one of the processes proximal to their adolescent's conduct problems is a primary target of MST. Put another way, virtually all families and adolescents

receiving MST will have functioning or skills deficits in a variety of domains, given the adolescent's need for MST services. The issue is whether these deficits are primary targets for remediation by MST. The Proximal Process moderation model would identify such patterns.

The purpose of the *Moderator Mechanisms of Causal Influence* model (and its two underlying patterns) is to provide guidance in making predictions about the patterns of statistical interactions that one may find in a treatment outcome study. Our hypotheses were based on the logic of these models, and the structure and focus of MST. Positive family relationships are seen as key to MST's efficacy, with family members more likely to work together effectively if they have positive relationships (Henggeler et al., 2009), and MST is parent- and family-focused with change in adolescents' behavior heavily dependent on the parent (Ellis, Weiss, Han, & Gallop, 2010). We therefore predicted that adaptive family characteristics including (a) positive family relationships, (b) parental warmth towards the adolescent, and (c) low levels of parent psychopathology would show Facilitation moderation patterns, with more adaptively functioning families (i.e., those with higher levels of positive family relationships and parental warmth, and lower levels of parent psychopathology) showing more positive response to treatment.

We also predicted that Proximal Process moderation patterns would be found in relation to parenting skills. In MST, deficits in adaptive parenting skills are seen as a proximal cause of adolescent conduct problems, and remediation of these deficits is a central target of MST. We therefore hypothesized that lower levels of adaptive parenting skills (e.g., parental discipline firmness; consistent monitoring of the adolescent and enforcement of rules) and higher levels of maladaptive parenting behaviors (e.g., permissive discipline behavior; harsh punishment; psychologically manipulative behavior) would show a Proximal Process moderation pattern, with lower levels of adaptive parenting skills and higher levels of maladaptive parenting behavior associated with better MST outcomes.

Method

Participants

Data for the present study were obtained from Weiss et al. (2013), a randomized MST outcome study. Participant adolescents for this study were selected from Moderate Intervention Program (MIP) classrooms in public schools, which are full-time, self-contained behavioral classrooms (i.e., the student spends the entire school day in this classroom, except for lunch, P.E., etc.) and are the highest level of restrictive placement in the general education schools in the school district in which the study was conducted. Students are placed in MIP classrooms because their conduct problems are sufficiently problematic such that they are unable to be educated in a less restrictive setting. Although our participants were not obtained through the legal system, approximately 68% had legal/court involvement at baseline. Of 213 families who were approached for participation, 164 agreed to participate, 91% completed the treatment program, 5% (6 Comparison, 2 MST) moved or were unable to be located prior to the final assessment, and 4% (2 Comparison, 4 MST) withdrew prior to the end of the study (see Weiss et al., 2013, for Consort Flow Diagram). Eighty participants were randomly assigned to the Comparison group and 84 to

the MST group. Table 1 provides demographic information for the MST and Comparison groups at the beginning of their project involvement. Mean T-scores at baseline for parent-report, teacher-report, and youth self-report Child Behavior Checklist (Achenbach & Rescorla, 2001) Externalizing Problems were 67.8 (96th percentile), 67.0 (96th percentile), and 59.7 (83rd percentile); also at baseline 87%, 85%, and 52%, respectively, of our sample scored at or above the borderline clinical range for Externalizing Problems, with 96% of the sample scoring at or above the borderline clinical range for Externalizing Problems for one or more informants. And although the sample was selected from special education classrooms for students with significant behavior problems, 86% of the sample scored within or above the borderline clinical range for Internalizing Problems (anxiety, depression, etc.) for one or more informants.

Comparison and MST Groups

Comparison group—A treatment as usual comparison group was used. Comparison group members were assessed on the same schedule as the MST group members, but received no intervention from the project. Treatment as usual consisted of the services provided by the MIP classrooms, behaviorally-focused individual and classroom management plans (e.g., negative consequences for unwanted behavior; reinforcement of positive behavior).

MST—MST treatment is multifaceted, targeting disturbance in the behavior of individuals, family, peer and dyadic relationships. The MST treatment model does not involve use of a unique set of techniques but rather interventions for each family are integrated from empirically-validated treatment models (e.g., behavioral parent training; cognitive-behavior therapy). Intervention is guided by the nine MST treatment principles (e.g., therapy should emphasize the positive and should use strengths as levers for change), the goal of which is to empower parents to manage their adolescent's life more adaptively (see Henggeler et al., 2009, for program details). In the present study, treatment lasted on average 5.19 months (SD =1.41), and 88% of cases were considered to have been closed successfully, and 8% were considered to have been closed partially successfully. See Weiss et al. (2013) for specific services, etc. provided and details regarding clinicians, clinical training, and supervision.

Measures

Measures focused on (a) basic demographics for sample description purposes; (b) outcome measures assessing adolescent conduct problems using parent, adolescent, and teacher reports; and (c) potential moderators. Based on our hypotheses that adolescents with more adaptively functioning families and with parents with higher levels of parenting skills deficits would gain more from MST, potential moderators focused on (c1) parent psychopathology; (c2) parents' discipline and parenting behavior; and (c3) family relationships and functioning.

Demographics—For the purposes of sample description, parents completed a demographic questionnaire. Factors assessed included age, gender, etc. of the adolescent and the primary caregiver, family structure, SES variables, etc. (see Table 1).

Outcome measures—Parents completed the Child Behavior Checklist (CBCL), adolescents completed the Youth Self-Report form (YSR), and teachers completed the Teacher Report Form (TRF; Achenbach & Rescorla, 2001). These are broad-band measures of adolescents' behavioral and emotional problems, in which parents, adolescents, and teachers report on the adolescent's functioning in regard to 118 problem behaviors, rating each problem 0 (*Not True*), 1 (*Somewhat or Sometimes True*), or 2 (*Very True or Often True*). Because MST focuses on treatment of conduct problems, the present study used the Externalizing Problems scales that assess aggressive and delinquent behavior from each of these three measures. In the present sample at baseline, internal consistency on the Externalizing Problems scale for the parents, adolescents, and teachers respectively was .89, .85, and .93. Validity of these scales is well established with, for instance, criterion validity demonstrated through the scales discriminating between referred and non-referred children (Achenbach & Rescorla, 2001).

Parent psychopathology—Parents rated their own symptoms using the Personality Assessment Inventory (PAI; Morey, 1991), an inventory of adult personality and psychopathology. The PAI items are rated on a 4-point Likert scale (Not At All True to Very True). The present study used the higher order *Internalizing* (e.g., *Depression, Anxiety*) and *Externalizing* (e.g., *Anti-social, Aggressive*) factors (Ruiz & Edens, 2008). In the present sample, internal consistency at baseline for the Internalizing and Externalizing factors was .87 and .83, respectively. The validity of the PAI has been established through, for instance, construct validity correlations between the PAI factors and life functioning variables (Slavin-Mulford et al., 2013).

Parenting behavior—Parents and adolescents completed the Children's Report of Parental Behavior Inventory (CRPBI; Schludermann & Schludermann, 1988). The parent informant rated himself or herself, and adolescents rated their maternal and paternal figures. For the adolescents, only the ratings of the maternal figure were used, as 100% of the sample had a maternal figure whereas about 40% of the adolescents did not have a paternal figure. The CRPBI items are rated on a 3-point Likert-type scale (Not Like Parent, Somewhat Like Parent, A Lot Like Parent). It produces three scales: (a) Firm vs. Lax (parental) Control, (b) parental support for Psychological Autonomy vs. Psychological Control, and (c) Parental Warmth. In the present sample, internal consistency for these three scales at baseline was .70, .81, and .85 for the parent, and .64, .71, and .90 for the adolescent. The CRPBI shows good validity with, for instance, convergent validity supported by correlations with the Parent Bonding Instrument parenting scale (Safford, Alloy, & Pieracci, 2007).

The parent informant also completed the Parental Authority Questionnaire (PAQ; Buri, 1991), which assesses parenting styles. Its 28 items are rated on a 5-point Likert scale ranging from Strongly Disagree to Strongly Agree. It produces three scales: Authoritarian Parenting (e.g., arbitrary, changing rules delivered in a harsh manner), Authoritative Parenting (e.g., consistent use of explicit rules in the context of a warm parent-child relationship), and Permissive Parenting (e.g., few if any rules). In the present sample, internal consistency for these three scales was .75, .74, and .69, respectively. The validity of

the PAQ has been established through, for instance, significant positive concurrent validity correlations between the PAQ Authoritative subscale and the Parental Nurturance Scale, and significant negative discriminant validity correlations between the PAQ Authoritarian subscale and the PNS (PNS; Buri, 1991).

Family functioning—Parents completed the Family Adaptability and Cohesion Evaluation Scales-III (FACES-III; Olson, Portner, & Lavee, 1985) which measures family functioning in instrumental and affective family relations. Its items are rated on a 5-point Likert scale ranging from 1 (Almost Never) to 5 (Almost Always), and produce two subscales. The Cohesion subscale assesses familial closeness and emotional support. The Adaptability subscale assesses the family's ability to adjust to daily stresses through renegotiation of family rules and roles. In the present sample, internal consistency for the Cohesion and Adaptability scales at baseline was .86 and .73, respectively. Its validity has been established, for instance, through convergent validity correlations across multiple measures of cohesion and adaptability, and different informants within the family (e.g., Edman, Cole, & Howard, 1990).

Treatment fidelity data

To assess treatment fidelity, every four weeks parents completed the MST Therapy Adherence Measure (TAM; Henggeler & Borduin, 1992), a 26-item questionnaire assessing family and therapist behaviors related to MST principles that produces 6 subscales. In addition, MST sessions were audiotaped with the family's permission, and randomly selected tapes were evaluated for treatment fidelity by the developers of MST.

Procedures

Most parent assessments took place at the home, although on occasion assessments took place at other locations at the request of the parent. Because some parents were of relatively low educational level, a research assistant read each measure to the parent who followed along and answered on their own copy of the measure. Adolescents were individually administered the assessments at home, but occasionally were assessed at school when more convenient for the family. Research assistants were blind to group assignment. Teachers were given assessment materials and completed the assessments on their own time. Primary outcome assessments occurred at four timepoints: (a) baseline, (b) 3 months, (c) 6 months, and (d) 18 months. Parents received \$50 per assessment, adolescents \$20, and teachers \$10 per adolescent per assessment.

Results

As the first step in data analysis, MST and comparison groups were compared on baseline demographic and background variables. None of these analyses were statistically significant, indicating that no variables needed to be included as covariates in outcome analyses.

MST Fidelity

Parents completed 307 Therapist Adherence Measures (TAM). On a 5-point scale ranging from 1=*not at all* to 5=*very much*, means and SD for the six TAM factors were: (a)

Therapist Attempts to Change Family's Interactions mean=3.29, SD=1.13; (b) *Therapeutic Lack of Direction* mean=1.60, SD=.66; (c) *Family-Therapist Consensus* mean=4.45, SD=.56; (d) *Adherence* factor mean=4.41, SD=.51; (e) *Non-productive Sessions* mean=1.52, SD=.66; (f) *Effort to Solve Problems* mean=4.55, SD=.50. Thus, therapists' adherence to MST principles overall was moderately high to high, and consistent with results of other studies (e.g., Letourneau, Sheidow, & Schoenwald, 2002). Two hundred eighteen therapy tapes were coded by the MST expert, with mean adherence ratings in the moderate to high adherence range. On a 1 to 7 scale, the lowest mean rating was 4.61 (moderate adherence) for adherence to MST Principle 5 (*Interventions should target sequences of behavior within or between multiple systems*), and the highest mean rating was 5.92 (high adherence) for Principle 6 (*Interventions should be developmentally appropriate and fit the developmental needs of the family/youth*). Thus, overall therapists showed good adherence to MST principles.

Data Reduction

To reduce the number of analyses and to reflect the empirical structure of our data, we conducted an exploratory factor analysis on the parent-child relationship and parenting behavior variables. We used maximum likelihood estimation with squared multiple correlations as initial communality estimates, and a factor loading criterion of .40 (Stevens, 2009). To determine the number of factors we used the parallel analysis technique (Hayton, Allen, & Scarpello, 2004). This analysis indicated three factors, with the TLI (Tucker - Lewis Index) = .87 indicating acceptable fit (Tucker & MacCallum, 1997). A promax rotation was used on the three factors, with the three factors showing low inter-factor correlations (i.e., the maximum correlation was -.12). Loading on the first factor, which we labeled *Positive Parent-Child Relationship*, were the parent-report CRBPI Parental Warmth subscale ($\lambda=.57$) and the two parent-report FACES subscales (Family Adaptability, $\lambda=.88$; Family Cohesion, $\lambda=.73$). Loading on the second factor, which we labeled *Negative Parenting*, were the parent-report CRBPI Psychological Control ($\lambda=.79$) and the PAQ Authoritarian Parenting ($\lambda=.65$) subscales. Loading on the third factor, which we labeled *Firm Parenting*, were the parent-report CRPBI Firm Parenting ($\lambda=.69$) subscale and the PAQ Permissive Parenting ($\lambda= -.51$) subscale. The other parenting subscales (PAQ Authoritative Parenting, and the three adolescent-report CRBPI factors) that did not load on any of the three factors were analyzed as separate subscales. Because the PAI Internalizing and PAI Externalizing scales correlated .65, they were combined into a single Parental Psychopathology scale for analysis.

Structure of Main Analyses

A mixed models approach to longitudinal data analysis (Raudenbush & Bryk, 2002) was used, with Treatment Group as a fixed between-subjects effect, and linear and curvilinear (quadratic) effects of Time (across the four timepoints) as random factors. The linear effect for Time represented the extent to which the combined groups' rate of change differed from zero, whereas the quadratic effect of Time (Time x Time) represented the extent to which the combined groups' rate of change itself changed across time. Treatment Group x Time interactions represented the extent to which the two groups' rates of change differed, and Treatment Group x Time x Moderator (assessed prior to randomization) effects represented

the extent to which the effect of treatment across time differed as a function of the moderator; moderation was considered to be demonstrated by a significant Treatment Group x Time x Moderator (or Treatment Group x Time x Time x Moderator) interaction on the outcome (Kraemer, Wilson, Fairburn, & Agras, 2002). Intent to treat analyses were used throughout the analyses.

Since all change ultimately must be non-linear, the quadratic terms for Time were included in the analyses to provide the most complete and accurate description of change across time. Following the principle of scientific parsimony, our goal with the analyses was to accurately describe the relations among our data (operationalized by which effects were retained in the final models), with the least complexity necessary for this description to be accurate. Thus, we first tested the most complex term in our models, the 4-way Moderator x Treatment Group x Time x Time effect, with all lower order effects in the model. If this effect was significant, results from this model are reported in Table 2. If this effect was non-significant, we reduced the complexity of the model by dropping the non-significant 4-way interaction and testing a model including the linear Time by Moderator effect (Moderator x Treatment Group x Time) and the quadratic effect of Time (Time x Time) as well as all lower order effects. The quadratic effect for Time was tested (and included in the models if significant) to determine if there was curvilinear change that did not vary as a function of treatment or the moderator. In the tables below, we report significant moderator effects but we do not report the various lower order effects included in the models, as these are not of substantive interest.

For significant interaction effects, we followed the recommendations of Cohen, Cohen, West, & Aiken (2003). We plotted the MST and comparison groups' change across time at -1 and $+1$ SD from the mean of the particular moderator at baseline, using the parameter estimates from the model to plot the groups' change. We did not conduct simple effects subgroup analyses, because as noted by Hayes and Matthes (2009) simple effects are appropriate for a priori specified subgroup analyses but do not appropriately describe significant interaction effects. We also computed standardized effect sizes for the unique effects of the parameter estimates, using the approach for mixed models longitudinal data recommended by Verbeke and Molenberghs (2000). This effect size is in the metric of a correlation coefficient, which is converted to an R^2 . This approach is particularly appropriate for longitudinal data because it is based on the parameter estimate rather than comparison of single points. Table 2 includes these estimates.

To put the results of our moderator tests in context, we briefly report here overall treatment effects on the three dependent variables. For the parent-report CBCL, there was a significant linear Time x Treatment Group interaction, with a significant quadratic Time x Time effect. Both MST and comparison groups showed a decelerating decrease in symptoms (i.e., a downward sloping symptom line in conjunction with an upwards curve to the line), with the MST group's linear rate of decrease significantly greater than that of the comparison group ($R^2=.04$). The adolescent-report YSR showed significant Time x Treatment Group ($R^2=.05$), Time x Time, and Time x Time x Treatment Group ($R^2=.04$) effects, with the MST group showing a greater linear decrease than the comparison group. Treatment effects on the teacher-report TRF were non-significant. However, it is important to remember that the lack

of a significant effect for treatment (or any other variable) does not preclude significant interaction effects involving other variables with that variable (Lubin, 1961).

Moderator Analyses

Positive Parent-Child Relationship (PPCR) factor—This factor, which was a combination of the FACES Family Adaptability, FACES Family Cohesion, and the parent-report CRBPI Parental Warmth subscales, showed significant effects on all three dependent variables. For the CBCL, the Positive Relationship x Treatment Group x Time effect was significant, $F(1,126) = 4.15, p < .05$, with a significant quadratic Time x Time effect (see Table 2). To interpret the interactions, in Figure 1 we plotted the MST and comparison groups' change across time based on the parameter estimates at -1 and $+1$ standard deviations from the mean of the *Positive Parent-Child Relationship* factor (Cohen et al., 2003). In these figures, the y axis represents the level of externalizing problems (CBCL, etc.) z-score standardized so that the magnitude of the effect is more readily interpretable. The x axis represents Time, the number of months since baseline assessment. Thus, a line that is curved represents curvilinear change across time, and a line that is straight with a non-zero slope represents a linear change across time. As Figure 1 indicates, for the parent-report CBCL and the adolescent-report YSR, the Positive Relationship x Treatment Group x Time interaction reflected the fact that at low levels of positive parent-child relationship, change across time in the MST and comparison groups ran almost parallel. In contrast, at high levels of positive parent-child relationship, the MST group showed a greater negative slope than the comparison group, representing a greater rate of decrease in externalizing problems.¹

The teacher-report TRF, however, showed a more complex pattern, with a significant Positive Relationship x Treatment Group x Time x Time effect ($F [1,60] = 4.98, p < .05$). At low levels of positive parent-child relationship, the MST group initially showed more gain than the comparison group but by 18 months had lost most of these relative gains. In contrast, at high levels of positive parent-child relationship, the MST and comparison group were approximately parallel for the first 9 months but then separated, favoring the MST group.

Negative Parenting factor—This factor, which was a combination of the parent-report CRBPI Psychological Control subscale and the PAQ Authoritarian Parenting subscale, showed a significant moderator effect on the TRF. The Negative Parenting x Treatment Group x Time effect was significant ($F [1,181] = 4.03, p < .05$). At low levels of negative parenting, the comparison group showed decreasing externalizing problems as reported by teachers whereas the MST group showed a slight increase; in contrast, at high levels of negative parenting, the comparison group showed increasing externalizing problems, whereas the MST group showed decreasing externalizing problems (see Figure 2a)

¹It is important to note that the significant Time x Time effect indicates that there is a quadratic (curvilinear) effect for the total sample, collapsed across the treatment and moderator variables. The non-significant Positive Relationship x Treatment Group x Time x Time effect indicates that this curvilinear effect is constant across the four Treatment x Positive Relationship groups in the figure. Other figures should be interpreted similarly.

Firm Parenting factor—This factor, which was a combination of the parent-report CRBPI Firm Parenting subscale and the PAQ Permissive Parenting subscale (reverse scored), showed no significant moderator effects.

PAQ Authoritative Parenting—We found a significant moderator effect for Authoritative Parenting on the effects of treatment as assessed by the CBCL (see Table 2). The Authoritative Parenting x Treatment Group x Time x Time effect was significant ($F[1,119] = 3.93, p < .05$), as well as the Authoritative Parenting x Treatment Group x Time effect ($F[1,119] = 5.27, p < .05$) and the quadratic Time x Time effect. As Figure 2b shows, this interaction reflected relatively little difference between the shapes of the curves for the MST and comparison groups at low levels of Authoritative Parenting but clear differences favoring the MST group at high levels of Authoritative Parenting.

Adolescent report of CRPBI Psychological Control—No significant moderator effects were found for adolescent-report of their mother's CRPBI Psychological Control.

Adolescent report of CRPBI Warmth—A significant moderator effect was found for adolescents' report of their mother's CRPBI Warmth for the CBCL, with the Warmth x Treatment Group x Time x Time effect being significant ($F[1, 61] = 5.20, p < .05$). Figure 2c shows that, at low levels of maternal warmth, the MST group initially showed more improvement than the comparison group, but due to the curvilinear effect ended up at approximately the same point it started relative to the comparison group (i.e., there was little treatment effect). In contrast, at high levels of maternal warmth, the two curves separated and remained separated, favoring the MST group.

Adolescent report of CRPBI Firmness—Analyses indicated a significant moderator effect for adolescents' report of their mothers' CRPBI Firmness, with contrasting patterns on the CBCL and TRF. For the CBCL, the Firmness x Treatment Group x Time effect was significant ($F[1, 63] = 6.65, p < .05$), with the quadratic Time x Time effect also significant; see Table 2. As Figure 2d shows, at low levels of mother firmness, the MST group showed a clear trend toward more improvement than the comparison group; in contrast, at high levels of mother firmness, there was only a slight separation between the groups' curves. The effect of Firmness x Treatment Group x Time on the TRF also was significant ($F[1, 129] = 6.42, p < .05$) but showed a different pattern than that for the CBCL. At low levels of mother firmness, the comparison group showed greater improvement than the MST group, whereas the MST group showed a greater rate of improvement at high levels of mother firmness (see Figure 2e).

Parental Psychopathology—A significant moderator effect was found for parent psychopathology as assessed by parents' self-report PAI on the adolescent-report YSR (PAI x Treatment Group x Time x Time, $F[1,101] = 5.41, p < .05$), with the quadratic Time x Time effect also significant (see Table 2). As shown in Figure 3, at low levels of parent psychopathology, the MST and comparison groups showed consistently increasing separation across time, favoring the MST group. In contrast, at high levels of parent psychopathology, the MST group showed a greater decrease initially in child externalizing

problems (as reported by adolescents) than the comparison group that subsequently reversed directions, whereas the comparison group showed a small but steady decrease in child externalizing problems.

Discussion

Although the specific patterns of moderation were not entirely consistent with our hypotheses, as predicted our results did show both Facilitation and Proximal Process moderation. The moderator effects of *Positive Parent-Child Relationship* on the CBCL and the TRF, of *Authoritative Parenting* and *Parent Warmth* on the CBCL, and of *Mother Firmness* on the TRF showed a facilitation pattern. With one exception, these results are consistent with our predictions that participants with more positive family relationships and lower levels of parental psychopathology would show greater positive effects of MST on adolescent conduct problems. The one exception was *Mother Firmness*, which as a measure of adaptive parent discipline behavior was predicted to show a proximal process pattern.

For the moderator effects of *Positive Parent-Child Relationship* on the TRF and of *Parent Psychopathology* on the YSR, results were more complex. To about 9 months post-baseline, the moderator effects appeared to represent more of a proximal process model, with adolescents from families with lower levels of adaptive behavior and higher levels of parent psychopathology appearing to benefit more from MST. However, because of significant curvilinear effects, by 18 months (the end of the assessment time period) these effects had reversed, and the trajectory beyond 18 months suggested a facilitation model. Finally, consistent with predictions that the effects of MST would be stronger among families with higher levels of non-adaptive parenting behaviors (or lower levels of adaptive parenting behaviors), moderator effects of *Negative Parenting* on the TRF, and of adolescent-rated *Mother Firmness* on the CBCL showed a proximal process pattern.

For the factors showing a facilitation model, families with more adaptive functioning benefitted more from MST. For the informants (parents and adolescents) involved in the home (the primary focus of MST), this adaptive functioning consisted primarily of positive parent-child relationships, with the factors involved in these relationships including the *Positive Parent-Child Relationship* factor, CRPBI *Maternal Warmth*, and PAQ *Authoritative Parenting*. Authoritative parenting focuses on placing expectations and consequences on children's behavior, but it also centrally involves listening to one's children, and expressing warmth and nurturance, etc. (Baumrind, 1971; Lamborn et al., 1991). In contrast, rather than involving the parent-child relationship, the two significant proximal process effects involved parents' discipline behaviors. The *Negative Parenting* factor is comprised of the CRPBI *Psychological Control* factor and the PAQ *Authoritarian Parenting* factor. The former involves use of parental behavioral control strategies such as guilt induction (e.g., the parent reminding the child of all the things the parent has done for the child) whereas the latter involves the use of arbitrary power (e.g., setting strict rules with no explanation or discussion for their basis), both of which generally are seen as maladaptive (e.g., Lamborn et al., 1991). The CRPBI *Mother Firmness* factor, which involves parental rule-setting and enforcement, also showed a proximal process pattern with lower levels of this adaptive factor associated with more positive MST effects.

One possible explanation for the facilitation pattern is that among families with better parent-child relationships, the adolescent may be more receptive to the modifications suggested by the therapist that the parent tries to implement. More positive parent-adolescent relationships may help to establish a positive (or at least less negative) atmosphere during parent-adolescent interactions, which may decrease the likelihood that the adolescent will automatically react negatively to parents' disciplinary or redirecting behavior, making the adolescent more likely to respond to MST interventions (Henggeler et al., 2009). It is also possible that in emotionally connected families, adolescents may feel more a part of the family and that they can participate in making decisions or creating new rules (e.g., Farrell & Barnes, 1993); they thus may feel a greater sense of responsibility to regulate their own behavior. Similarly, it is possible that in the context of a positive parent-child relationship, parents may be more motivated, willing, and able to utilize the input of their therapist, and expend the energy to change their own behavior (Cunningham & Henggeler, 1999). In sum, adaptive family functioning and relationships may facilitate families' utilization of the MST intervention more fully, thus functioning as a moderator.

In regard to the proximal process effects, families with parents using less adaptive parenting discipline strategies had adolescents who appeared to benefit more from MST (and vice versa). In general, adaptive parenting is associated with lower levels of child or adolescent conduct problems (Luyckx et al., 2011), with maladaptive parenting behavior seen as a central (although of course not the only) factor in the development and maintenance of conduct problems (e.g., Loeber, 1990). Consequently, developing parents' use of adaptive discipline strategies is a central focus of MST, and seen as a primary proximal cause of change in MST and many other behavioral parent training programs (Huey, Henggeler, Brondino, & Pickrel, 2000). This suggests that among families wherein parents are already using relatively high levels of adaptive discipline (who in our sample appeared to benefit less from MST), the adolescent's conduct problems may be due primarily to other factors (e.g., exposure to neighborhood violence or association with deviant peers; Barrera et al., 2002) that are not primary processes targeted by MST, or more difficult to change. This in turn suggests that the proximal process moderator effects that we found may reflect the fact that the families who benefitted the most from MST (those with low levels of adaptive parenting strategies) did so because the proximal factors underlying their adolescents' conduct problems are central to the focus of MST (non-adaptive parenting strategies). These results suggest that although MST is individualized for each family to address its specific circumstances, not surprisingly these efforts are not always entirely successful. If individualization were fully successful, there should be few significant moderators of treatment effects, as individualization would equalize strengths and deficits across families, resulting in approximate equal outcomes, and no significant moderators.

Clinical implications

Traditionally, moderator analyses have been used to identify who will benefit most from a treatment, which can be used for treatment selection or client assignment purposes (Beutler, Harwood, Bertoni, & Thomann, 2006). Moderator analyses also have been used to suggest for which groups and how a treatment might be modified in order to increase its efficacy (e.g., Manders et al., 2013). Both of these apply to facilitation and proximal process

moderation patterns. However, in addition, a clinical implication from our model and results is that factors consistently identified as facilitation moderators may serve as useful foci for MST's strength-based levers of change approach. For instance, if our finding that positive family relationships function as a facilitation moderator was replicated, then this would suggest that positive family relationships should be a strength-based focus for MST. If an adolescent does not have positive family relationships, then such relations should be developed or identified outside the immediate family. And in fact, a focus on positive family relationships is a central part of MST (Henggeler, et al., 2009), and these findings confirm the importance of this intervention focus. Conversely, if a factor (e.g., involvement in sports) were found consistently to not be a facilitation moderator, given limited resources it then might not be an optimal strength-based focus for intervention, since adolescents high on the characteristic have similar outcomes to adolescents low on the characteristic. Efforts might be better spent on strengths that are facilitation moderators.

It is important to note that our results (e.g., that MST and comparison families low on positive parent-child relationships do not differ significantly on CBCL outcome) do not directly suggest that MST is not effective for less psychologically well-resourced families. Rather, given that we found both facilitation and proximal process moderation effects, it suggests MST may work through different avenues for different families, and in all likelihood both processes can occur in an individual family.

Strengths and limitations of this study should be noted. One strength was the use of participants who were obtained through the schools rather than the legal system, which allows for broader generalizability vis-à-vis adolescents with conduct problems as compared to those recruited through the legal system, the usual source of adolescents for MST outcome studies. On the other hand, the extent to which our findings were influenced by the use of the school as the source of the adolescents and how applicable results are to MST samples obtained through the court system is less clear. A central limitation of the study is that although participants were randomly assigned to the MST or comparison conditions, they were not randomly assigned to levels of the moderators. Thus, it is not possible to rule out third variable explanations for our moderator effects. For instance, it is possible that the moderator relation between positive family relationships and MST outcomes could be due to the influence of a third variable with which positive family relationships and MST outcomes were correlated, such as parent psychopathology. However, the lack of random assignment to levels of the moderators, and the possibility of third variable explanations, is true for virtually all tests of treatment moderators. Finally, a moderate number of analyses were conducted, which always raises the possibility that some findings are spurious and due to chance.

Although the present study focused on the MST intervention, the model should be able to be applied to other studies of treatment moderation. One important aspect of such future studies will be to see if it can increase the a priori accuracy of predictions of treatment moderation, which is the fundamental goal of the treatment moderation model.

Overall, we found a number of significant moderators of the effects of MST, and these results highlight the value of considering moderators beyond basic demographic

characteristics. Our results also illustrate the value of a *Moderator Mechanisms of Causal Influence* approach to conceptualizing moderators, as this approach can provide an overall theoretical structure to moderator studies, suggest underlying mechanisms for moderators' effects, and provide guidance for making a priori theoretical hypotheses. Finally, our results highlight that moderator effects for a particular treatment program do not have to follow only a facilitation model or only a proximal process model. Positive effects of MST on adolescent conduct problems were larger among families with higher levels of positive family relationships and parental mental health (suggesting a facilitation model), but also for families with lower levels of adaptive parenting behaviors (suggesting a proximal process model). Thus, moderator patterns may vary as a function of the role that the moderator plays in the treatment and in the initial causal development of the psychopathology.

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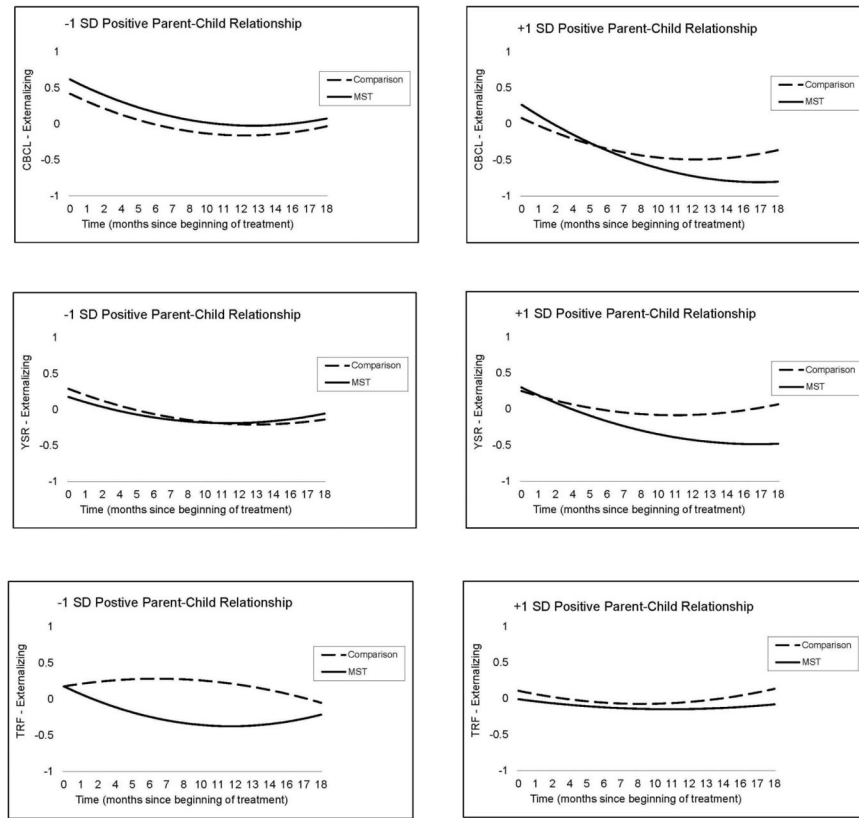


Figure 1. Moderator effects of *Positive Parent-Child Relationship* factor on CBCL, YSR, and TRF externalizing psychopathology

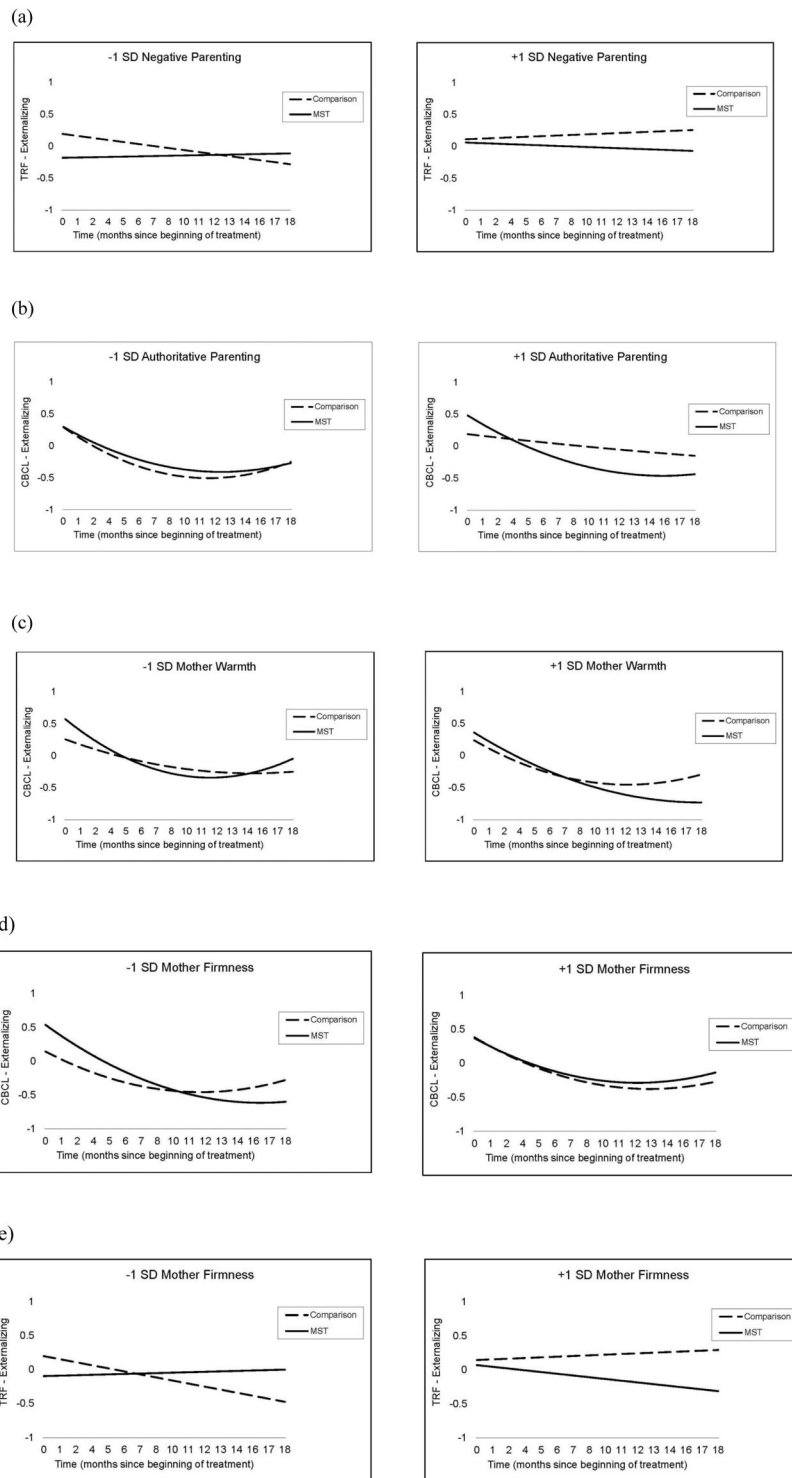


Figure 2. Moderator effects of parenting factors on CBCL, YSR, and TRF externalizing psychopathology

(a) Moderator effect of *Negative Parenting* on TRF Externalizing Problems scale; (b) Moderator effect of PAQ *Authoritative Parenting* on CBCL Externalizing Problems scale; (c) Moderator effect of CRPBI *Mother Warmth* on CBCL Externalizing Problems scale; (d, e) Moderator effect of CRPBI *Mother Firmness* on CBCL and TRF Externalizing Problems scales.

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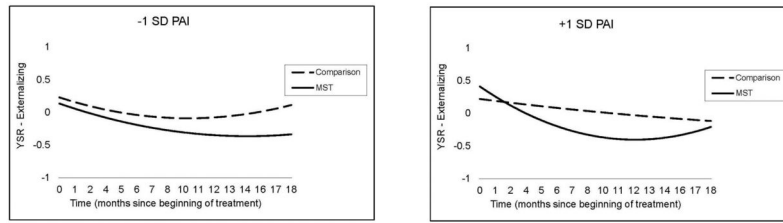


Figure 3. Moderator effects of *PAI Parent Psychopathology* on YSR externalizing problems

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Table 1

Demographic characteristics

	MST Group	Comparison Group
Adolescent		
Mean age in years (SD)	14.6 (1.3)	14.5 (1.4)
% Male	83%	83%
% African American	56%	64%
% Caucasian	44%	36%
Parent informant		
Mean age in years (SD)	41.5 (9.5)	40.0 (8.0)
% Biological mother	75%	79%
% Biological father	4%	9%
% Single parent/caregiver	67%	75%
Median education (years)	13.0 (2.1)	12.3 (2.0)
Family		
Median annual income	\$17,500	\$17,500
# Adults in household	1.8 (0.8)	1.8 (0.9)
# Children in household	2.4 (1.4)	2.4 (1.4)

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Table 2

Significant moderator effects

Moderator	Dependent Variable	Factor	F	R ²
	CBCL	PPCR x Tx Group x Time	4.15 [*]	.03
		Time x Time	50.26 ^{****}	.25
Positive Parent-Child Relationship (PPCR)	YSR	PPCR x Tx Group x Time	8.03 ^{**}	.07
		Time x Time	30.49 ^{****}	.18
	TRF	PPCR x Tx Group x Time x Time	4.98 [*]	.08
Negative Parenting (NP)	TRF	NP x Tx Group x Time	4.03 [*]	.02
PAQ Authoritative Parenting (AVP)	CBCL	AVP x Tx Group x Time x Time	3.93 [*]	.03
		AVP x Tx Group x Time	5.27 [*]	.04
		Time x Time	38.19 ^{****}	.17
CRPBI-Adol Mother Warmth	CBCL	Warmth x Tx Group x Time x Time	5.20 [*]	.08
		Time x Time	54.16 ^{****}	.28
CRPBI-Adol Mother Firmness	CBCL	Firmness x Tx Group x Time	6.65 [*]	.10
		Time x Time	58.23 ^{****}	.30
	TRF	Firmness x Tx Group x Time	6.42 [*]	.05
PAI Parent Psychopathology	YSR	PAI x Tx Group x Time x Time	5.41 [*]	.05
		Time x Time	25.53 ^{****}	.17

Note.

* $p < .05$,

** $p < .01$,

**** $p < .0001$.

CBCL = CBCL Externalizing Problems scale; YSR = YSR Externalizing Problems scale; TRF = Externalizing Problems scale; PPCR = *Positive Parent-Child Relationship*; NP = *Negative Parenting*; PAQ = Parental Authority Questionnaire; CRPBI-Adol = CRPBI adolescent report; Tx Group = Treatment Group (Treatment vs. Comparison).