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Family Processes and Treatment Outcome in the MTA: Negative/Ineffective Parenting Practices in Relation to Multimodal Treatment[1]

Stephen P. Hinshaw,[2] Elizabeth B. Owens,[3] Karen C. Wells, Helena C. Kraemer, Howard B. Abikoff, L. Eugene Arnold, C. Keith Conners, Glen Elliott, Laurence L. Greenhill, Lily Hechtman, Betsy Hoza, Peter S. Jensen, John S. March, Jeffrey H. Newcorn, William E. Pelham, James M. Swanson, Benedetto Vitiello, and Timothy Wigal

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To elucidate processes underlying therapeutic change in a large-scale randomized clinical trial, we examined whether alterations in self-reported parenting practices were associated with the effects of behavioral, medication, or combination treatments on teacher-reported outcomes (disruptive behavior, social skills, internalizing symptoms) in children with attention-deficit hyperactivity disorder (ADHD). Participants were 579 children with Combined-type ADHD, aged 7–9.9 years, in the Multimodal Treatment Study of Children with ADHD (MTA). We uncovered 2 second-order factors of parenting practices, entitled Positive Involvement and Negative/Ineffective Discipline. Although Positive Involvement was not associated with amelioration of the school-based outcome measures, reductions in Negative/Ineffective Discipline mediated improvement in children's social skills at school. For families showing the greatest reductions in Negative/Ineffective Discipline, effects of combined medication plus behavioral treatment were pronounced in relation to regular community care. Furthermore, only in combination treatment (and not in behavioral treatment alone) was decreased Negative/Ineffective Discipline associated with reduction in children's disruptive behavior at school. Here, children in families receiving combination treatment who showed the greatest reductions in Negative/Ineffective Discipline had teacher-reported disruptive behavior that was essentially normalized. Overall, the success of combination treatment for important school-related outcomes appears related to reductions in negative and ineffective parenting practices at home; we discuss problems in interpreting the temporal sequencing of such process-outcome linkages and the means by which multimodal treatment may be mediated by psychosocial processes related to parenting.

KEY WORDS: attention-deficit hyperactivity disorder (ADHD); stimulant medication; behavior therapy; multimodal treatment; parental discipline; psychotherapy process research.

[1]The MTA (Multimodal Treatment Study of Children with Attention Deficit Hyperactivity Disorder) is a cooperative treatment study performed by six independent research teams in collaboration with the staff of the Division of Clinical and Treatment Research of the National Institute of Mental Health (NIMH), Rockville, Maryland and the Office of Special Education Programs (OSEP) of the U.S. Department of Education (DOE). The NIH Principal Collaborators are Peter S. Jensen, M.D., L. Eugene Arnold, M.Ed., M.D., John E. Richters, Ph.D., Joanne B. Severe, M.S., Donald Vereen, M.D., and Benedetto Vitiello, M.D. Principal Investigators and Coinvestigators from the six sites are as follows: University of California, Berkeley/San Francisco (U01 MH50461): Stephen P. Hinshaw, Ph.D., Glen Elliott, M.D., Ph.D.; Duke University (U01 MH50447): C. Keith Conners, Ph.D., Karen C. Wells, Ph.D., John S. March, M.D., M.P.H.; University of California, Irvine/Los Angeles (U01 MH50440): James M. Swanson, Ph.D., Dennis P. Cantwell, M.D., Timothy Wigal, Ph.D.; Long Island Jewish Medical Center/Montreal Children's Hospital (U01 MH50453): Lily Hechtman, M.D.; New York University School of Medicine, NYU Child Study Center: Howard B. Abikoff, Ph.D.; New York State Psychiatric Institute/Columbia University/Mount Sinai Medical Center (U01 MH50454): Laurence L. Greenhill, M.D., Jeffrey H. Newcorn, M.D.; University of Pittsburgh (U01 MH50467): William E. Pelham, Ph.D., Betsy Hoza, Ph.D. Helena C. Kraemer, Ph.D. (Stanford University) is statistical and design consultant. The OSEP/DOE Principal Collaborator is Ellen Schiller, Ph.D.

[2]Address all correspondence to Stephen P. Hinshaw, Department of Psychology, Tolman Hall No. 1650, University of California, Berkeley, California 94720 1650; e-mail: hinshaw@socrates.berkeley.edu.

[3]Institute of Human Development, University of California, Berkeley, California.

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INTRODUCTION

Investigators of psychotherapy have long distinguished outcome research from process research (e.g., Bergin & Garfield, 1994). As discussed in Hoagwood, Hibbs, Brent, and Jensen (1995), the aim of outcome research is to establish whether treatments are efficacious (i.e., do they produce change in tightly controlled research settings?) or effective (are they clinically meaningful in real-world applications?). The objective of process research, on the other hand, is to identify and describe what occurs during treatment. Ideally, these endeavors can be coordinated through an approach that first establishes *whether* a treatment is associated with meaningful effects on outcomes of interest and then specifies *how* aspects of the therapeutic process are responsible for such improvements. Findings generated using this two-step approach may have important implications for both basic and applied psychological science. That is, determining the processes underlying a treatment effect can suggest mechanisms of psychological change and can also provide information necessary for reproducing treatment effects, thus informing efficient and judicious application of an intervention.

Within the field of clinical child psychology, effective treatments are being sought for a variety of disorders, including attention-deficit hyperactivity disorder (ADHD), a prevalent and impairing form of psychopathology (Barkley, 1998; Hinshaw, 1994). For the treatment of ADHD, pharmacologic (methylphenidate and other stimulants) and behavioral (both family- and school-based) interventions have each shown clear, short-term benefits for core symptoms as well as associated features such as academic failure and aggressive behavior problems (Greenhill, 1998; Hinshaw, Klein, & Abikoff, 1998; Pelham, Wheeler, & Chronis, 1998). To evaluate the relative and combined effectiveness of such treatments across a longer time interval, the National Institute of Mental Health instituted the Multimodal Treatment Study of Children with ADHD (MTA), a randomized, multisite clinical trial (for background, see Arnold et al., 1997; Richters et al., 1995). In this 6-site trial, 579 children, aged 7.0–9.9 years and carefully diagnosed with Combined-type ADHD, were assigned randomly to one of four treatments for 14 months of intervention.

As reported by the MTA Cooperative Group (1999a), initial outcome data reveal the following: (1) Despite improvements across time for all MTA treatments, for the outcome domain of ADHD symptomatology, medication management alone (MedMgt) and combined medication management plus intensive behavior therapy (Comb), which did not significantly differ, were superior to intensive behavior therapy alone (Beh) and a community comparison condition (CC), which did not differ. Note that the CC condition involved familial choice of community intervention, which included stimulant medication for two-thirds of the participants. (2) For the additional outcome domains of comorbid symptomatology (oppositional/aggressive, internalizing symptoms) and functional skills (social skills, parent–child relations, and academic performance), group differences were smaller, with results supporting Comb as the only condition consistently superior to CC. (3) For all core analyses, no interactions of site with treatment occurred, attesting to the robustness of the findings across six performance sites. (4) In terms of both a categorical definition of "excellent response" regarding disruptive behavior symptoms and a broader composite outcome measure amalgamated across broad symptom and functional domains, Comb significantly outperformed MedMgt, with a small-to-moderate effect size for this contrast (Conners et al., in press; Swanson et al., in press). (5) Although overall findings were quite consistent for boys versus girls, for children with/without prior medication treatment, and participants with/without disruptive comorbidity, two baseline variables (comorbidity with an anxiety disorder and socioeconomic status) moderated some treatment outcomes. Most notably, ADHD/Anxious children fared relatively better with treatments incorporating Beh regarding reduction of ADHD and internalizing symptoms (MTA Cooperative Group, 1999b); for this comorbid subgroup, the effectiveness of Beh did not differ significantly from that of Comb or MedMgt.

Given these initial findings regarding MTA treatment outcomes, the pertinent question shifts to process variables: How were particular aspects of MTA treatments associated with improved child outcomes? In other words, what processes may have served to explain the treatment effects? Authorities in the field have contended that understanding of both moderator variables and mediator processes responsible for producing treatment effects are high priorities for research efforts in child psychotherapy (Kazdin & Weisz, 1998). Explanatory processes may occur at multiple levels within the child (e.g., neurophysiological, cognitive, or affective changes), the parent (e.g., changes in attitudes, perceptions, or parenting behaviors), the parent–child relationship (e.g., improved affective quality or communication), or even wider systems (e.g., amelioration of school, peer, or community environments). Herein, we focus on parenting behavior and parent–child relationship variables as key processes. Our rationale is twofold. First, MTA behavioral treatments targeted parenting behaviors directly and parent–child relationship

quality indirectly, through the intensive, multisession parent training (Wells et al., this issue-b). Thus, enhancement of parenting skills *could* plausibly serve to mediate gains from Beh or Comb condition. Second, coercion theory (Patterson, 1982) predicts that changes in parental disciplinary practices (e.g., increased consistency and supervision; decreased harshness) and in parent-child interaction (e.g., reductions in negative reinforcement patterns) would effect behavioral improvement in externalizing domains. Indeed, decades of socialization research have clearly established that these and other family socialization practices are related to child behavior and adjustment, especially regarding aggressive actions (e.g., Patterson, Reid, & Dishion, 1992). Changes in such family process variables, therefore, *should* be related to improved child outcomes.

Moderator and Mediator Effects in Child Intervention Research

According to the classic work of Baron and Kenny (1986), a moderator alters the pattern of association between two variables of interest (e.g., if the association between variables A and B differs for boys and girls, sex is said to moderate the A–B association). Testing for the presence of a hypothesized mediator is more complex, requiring the following: (a) an empirical relationship between two variables (for our purposes, treatment condition and outcome), (b) an empirical relationship between treatment condition and the putative mediator, (c) an empirical relationship between the putative mediator and the outcome, and (d) an attenuation or disappearance of the initial relationship (between treatment and outcome) when the effect of the mediator is controlled. In other words, the mediator variable accounts for or explains the treatment effect.

Kraemer, Stice, Kazdin, Offord, and Kupfer (2000) provide elaboration, with specific implications for clinical trials. If A, B, and O are three events that occur in temporal succession (e.g., treatment assignment, parenting practices, and child outcome), then A *moderates* the effect of B on O if it is uncorrelated with B and has an interactive effect with B on O. Thus, in our example, if treatment condition is unassociated with change in parenting practices but parenting practices differ significantly in their effect on child outcome across different treatment conditions, then treatment condition can be said to moderate the effect of parenting on outcome. More traditionally, a pretreatment characteristic like sex of the child or family SES could moderate the effect of treatment on outcome, when patterns of treatment effects differ significantly for boys and girls or across social strata. On the other hand, B *mediates* the effect of A on O if (a) B is correlated with A and (b) has an interactive effect with A on O (partial mediation) or exerts a main effect (mediation) on O. Following our example, if treatment condition produces an effect on parenting practices, and if parenting practices in turn interact with treatment condition to yield differential effects on child outcome, then parenting practices partially mediate the effects of treatment assignment (see Kraemer et al., 2000, for further description and conceptual clarification).

Only two published studies have directly examined the mediation of psychosocial treatment effects on child/adolescent outcomes by parenting variables (i.e., by parenting behaviors that were a target of intervention). In both investigations, parents of youth with conduct problems (rather than ADHD per se) received behaviorally based family treatment. Although neither report demonstrated an attenuation or disappearance of the relation between treatment and outcome when the mediator was controlled, in both studies the presence of a mediator was inferred because demonstrated changes in family processes were associated with improved child outcomes. First, Dishion, Patterson, and Kavanagh (1992) showed that (a) parental treatment was related to modest decreases in maternal use of negative discipline and (b) maternal negative discipline scores at termination were related, in the expected fashion, to reductions in child antisocial behavior. Second, Patterson and Forgatch (1995) demonstrated that behavioral family treatment predicted both long-term improved outcome (fewer out-of-home placements, lower arrest rates) and changes in family process (in parental discipline, monitoring, or family problem-solving). Crucially, treatment-induced changes in these family processes, measured by scores at termination, were associated with child outcome. All three of the family process variables predicted reduced rates of out-of-home placements, whereas only monitoring and family problem-solving predicted lowered arrest rates.

Other examples of mediator relationships have recently appeared in the child literature. The Conduct Problems Prevention Research Group (1997) demonstrated that the effects of an intensive, psychosocial, parent–school preventive intervention for conduct problems on the outcome of school- based special services was partially mediated by the effects of the treatment on several family-level variables (e.g., parental discipline, skill, warmth, and attitude toward the child). That is, when the effects of treatment on these parental mediators were taken into account, intervention effects on reducing special education placement were attenuated. This same report, however, showed even stronger mediational effects for child-centered (sociocognitve and peer preference) variables regarding this

same outcome. In addition, utilizing a randomized clinical trial of early preventive intervention, Vitaro, Brendgen, Pagani, Tremblay, and McDuff (1999) recently showed that reduction of risk for conduct disturbance was at least partially mediated by enhancing the quality of peer relationships.

With ADHD samples, several investigations have suggested mediational effects of parenting variables, by separately testing relations between (a) treatment and outcome and (b) treatment and changes in family process, without specifically examining whether changes in the latter domain predicted changes in the former. For example, Pisterman et al. (1989) showed that among parents of preschoolers with ADHD, parent training was associated with both improved child behaviors and with enhancement of targeted parent behaviors (e.g., lowered use of indirect commands). Similar examples with older samples include the investigations of Barkley, Guevremont, Anastopoulos, and Fletcher (1992) and Anastopoulos, Shelton, DuPaul, and Guevremeont (1993). Although these studies do not suffice as tests of treatment mediators, they provide indirect support for the hypothesis that family process variables are related to outcome in treatments for ADHD.

In sum, family process and parenting variables appear to mediate the effects of behaviorally based family treatment for childhood externalizing problems, with indirect evidence for such mediation effects with ADHD populations. A number of questions, however, remain. First, the form of the family change necessary for mediation (parent disciplinary style, quality of family interaction, or parental functioning more generally) is indeterminate, particularly related to ADHD. Second, the types of child outcomes affected by family process mediators have been limited to externalizing symptomatology per se. It is unknown whether outcomes related to functional impairment (particularly social skills deficits) or to internalizing comorbidities may also be mediated by family process or parenting changes. Third, it is conceivable that effects of treatments that are not explicitly behavioral or family-based could also be mediated by changes in therapeutic or family processes. For example, in the Treatment of Depression Collaborative Research Program, clinical improvement for adult unipolar depression was related to quality of the therapeutic relationship, even in a group treated with antidepressant medication (Blatt, Zuroff, Quinlan, & Pilkonis, 1996). In the child field, it is well known that ADHD children's receipt of stimulant medication induces immediate reductions in child noncompliance and negativity, with consequent reductions in parental negativity (e.g., Barkley & Cunningham, 1979). Medication treatment apparently reduces the need for controlling negative discipline practices. Whether such improved parenting, in turn, mediates more generalized or lasting behavior change in the child is unknown. We, therefore, consider the possibility that that medication-related improvement in family relationships and parenting could mediate important child outcomes in nonfamily domains.

Study Aims

Our chief goal is to extend the initial, hypothesis-driven, intent-to-treat analyses of MTA outcomes and moderator effects (MTA Cooperative Group, 1999a, 1999b) toward exploration of explanatory processes in the realm of parenting practices. To index parenting variables, we factor analyzed two key parent self-report inventories from the MTA assessment battery. Because objective observational coding of videotaped parent–child interactions is ongoing, we cannot utilize such variables at present. In order to avoid shared method variance between these parental processes and crucial child outcome variables, for the latter, we focus only on measures completed by the children's teachers, emphasizing the domains of disruptive behavior, social skills, and internalizing symptoms. We predict that any parental "process" effects will be strongest for the Comb and Beh conditions, in which intensive, behavioral parent training occurred; but we do not rule out the possibility that school-based effects of pharmacologic intervention could also be mediated by improvements in parenting behavior. We also hypothesize that any such effects will emerge most clearly for the outcome of disruptive behavior, less strongly for social skills, and only weakly for internalizing symptomatology. Overall, the MTA's large sample and status as a randomized clinical trial provide a unique opportunity for exploring process-outcome linkages.

METHOD

Participants

Across six sites in the US and Canada, 579 MTA subjects were recruited and selected. Children were aged 7.0–9.9 years at intake and all were diagnosed with ADHD, Combined type (see Hinshaw et al., 1997, for details of screening, diagnosis, and assessment). The sample had 80% males and 61% Caucasians, ranging widely in SES. To enhance generalizability, the sample was intentionally selected to include comorbidities common to ADHD. Thus, at baseline, 34% had an anxiety disorder (beyond a simple phobia alone); regarding externalizing comorbidity, 40% had oppositional defiant disorder (ODD) and an

additional 14% displayed conduct disorder (CD). Children with rarer comorbidities demanding alternative treatments (e.g., psychosis, Tourette's Disorder) were excluded.

Procedures

In a 4-group parallel design, children were randomly assigned to MedMgt, Beh, Comb, or CC for 14 months of treatment. Note that (a) site was completely crossed with treatment condition, so that all interventions were delivered at all six performance sites; and (b) all children came from different classrooms, so that teachers did not rate multiple children.

Each active MTA treatment arm was designed as a management strategy, sufficiently robust and flexible to stand on its own and respond to clinical needs. MedMgt began with a 4-week, double-blind, placebo-controlled titration period followed by monthly medication management (see Greenhill et al., 1996). Beh included group and individual parent training, an intensive, child-focused summer treatment program (Pelham & Hoza, 1996), and school-based intervention, all delivered in a coordinated fashion (Wells et al., this issue). It began intensively and was tapered toward the end of the 14-month treatment interval. Comb involved the provision of both pharmacologic and behavioral treatments but comprised more than the simple addition of MedMgt and Beh: Its algorithms dictated changes in behavioral treatment strategies prior to medication adjustments. All three active interventions (MedMgt, Beh, and Comb) were manualized, with careful ascertainment of treatment fidelity and therapist competence throughout the intervention period. CC participants received no MTA treatments, but were provided a report of their initial assessments, along with a list of community mental health services and resources. For elaboration of study design issues, see Arnold et al. (1997). In order to assess treatment response, multisource and multidomain assessments (Hinshaw et al., 1997) were performed at baseline, 3 months and 9 months into treatment, and end of treatment (14-months).

Measures

Parenting Variables

Our battery featured two instruments. The parent version of the Alabama Parenting Questionnaire (APQ; Shelton, Frick, & Wooton, 1996) provides parental self-report of the frequency of 42 items—each scored from 1 ("never") to 5 ("always")—with regard to the following parenting practices: Corporal Punishment, Inconsistent Discipline, Poor Monitoring/Supervision, Involvement, and Positive Parenting. These five scales were formulated through a combination of empirical and rational means. Internal consistency for all scales except corporal punishment is moderate to high (Shelton et al., 1996), and test–retest correlations across a 3-year interval averaged .65 (McMahon, Munson, & Spieker, 1997). Convergent validity has been measured in the form of relations among APQ scores measured via self-report versus interview formats as well as associations between maternal parenting efficacy and satisfaction with high levels of APQ Involvement and Positive Parenting (Shelton et al., 1996; McMahon et al., 1997). These authors provided evidence for predictive validity in terms of significant associations between APQ scores and child disruptive behavior problems.

The 40-item parent version of the Parent–Child Relationship Questionnaire (PCRQ; Furman & Giberson, 1995) was designed to measure parent perception of relationship quality along several rationally derived dimensions. The major scales featured in MTA primary outcome analyses were Personal Closeness and Power Assertion. Items on the PCRQ are scored from 1 ("hardly at all") to 5 ("extremely much"). Although limited psychometric information is available regarding this measure, Furman and Giberson (1995) reported convergent validity, with moderate and expected relations between self-reported parent management techniques and the PCRQ scales. The PCRQ scales distinguished Comb from CC participants in the initial outcome analyses of the MTA (MTA Cooperative Group, 1999a).

Outcomes

From the 19 primary outcome variables in the core MTA outcome analyses (MTA Cooperative Group, 1999a), we defined a far smaller set, to avoid problems of (a) familywise alpha levels associated with multiple statistical testing and (b) shared method variance between parent-reported process variables and child outcome measures. We, therefore, selected three teacher-reported measures that demonstrated strong psychometric properties and that were measured on at least three occasions (as required by random-effects regression strategies). (1) For ADHD-related and oppositional symptomatology, we utilized a composite measure of disruptive behavior (DB) from the SNAP, a DSM-IV-based rating instrument (Swanson, 1992). Specifically, we utilized the 9 items tapping inattention, the 9 pertinent to hyperactivity/impulsivity, and the 8 indicators of ODD symptoms. All were scored on a metric of 0 ("not at all") to 3 ("very

much") and then averaged into a 26-item composite. At baseline, the mean teacher DB score was 1.86 ($SD = 0.56$); at 14-months, $M = 1.04$ ($SD = 0.67$). Swanson et al. (in press) demonstrate the strong treatment sensitivity and optimal psychometric properties of the DB scale. (2) For social skills, we utilized a 29-item scale from the Social Skills Rating System (SSRS; Gresham & Elliott, 1989) entitled Total Social Skills, tapping cooperation, prosocial behavior, and peer acceptance. Items are scored on a 3-point scale, from "never" to "very often"; higher scores indicate greater levels of social skill. Total Social Skills possesses favorable psychometric properties; it yielded significant treatment effects and was moderated by familial receipt of public assistance in the primary outcome analyses (MTA Cooperative Group, 1999a, 1999b). At baseline, the SSRS Total Social Skills $M = 0.83$ ($SD = 0.28$); at 14 months, $M = 1.10$ ($SD = 0.32$). (3) Although internalizing symptomatology may not be optimally measured via teacher report, we wished to include this domain as an outcome measure, utilizing the 6-item SSRS Internalizing scale. Items are scored on a 3-point scale ("never" to "very often"). This scale taps symptoms of anxiety and depression as well as social withdrawal. At baseline $M = 0.79$ ($SD = 0.47$), with 14-month $M = 0.64$ ($SD = 0.44$). Although the Internalizing Scale did not yield overall treatment effects in the main MTA analyses (MTA Cooperative Group, 1999a), it is possible for a measure without omnibus treatment effects to yield moderator or mediator effects (for example, one subgroup may show intervention-related gains but another does not; Kraemer et al., 2000).

Data Analytic Plan

To create empirically derived summary scores and to reduce the number of potential parenting variables, data from the APQ and PCRQ were standardized and submitted to a series of principal components analyses (PCA; see Wells et al., this issue-a). First, we submitted items from each scale to a separate PCA with varimax rotations. We then submitted the resultant first-order factor scores to a second-order PCA, also with varimax rotation, undertaking this step because of the conceptual overlap between the items and factors from each measure. We utilized baseline data from the primary caregivers (91% of whom were mothers) for these factor analyses. Decisions regarding factor retention in both the first- and second-order analyses were based on (1) eigenvalues of at least one, (2) adequate internal consistency of items for each factor, and (3) the clinical interpretability of factors. Once we derived second-order factors, we computed change scores, subtracting baseline from the end-of-treatment (14-month) second-order factor scores, which were standardized.

Because a proposed mediator variable must be correlated with treatment assignment (Kraemer et al., 2000), we next ascertained whether our parenting variables were influenced by the MTA treatment conditions, performing omnibus tests plus specific pairwise contrasts. We utilized pairwise rather than orthogonal contrasts (see Swanson et al., in press) in order to enhance the clinical interpretability of findings (e.g., which specific contrasts of treatment conditions were related to changes in parenting practices?). We then applied a random-effects (RR) model—the data analytic strategy utilized in the core outcome papers (MTA Cooperative Group, 1999a, 1999b; see also Gibbons et al., 1993)—to the parenting variable, including it both as a main effect and in interaction, utilizing SAS Proc Mixed. In cases of a significant overall interaction of the parenting variable $\times$ treatment condition on the trajectory of response ($p < .05$), we attempted to localize the effect analytically and graphically (see MTA Cooperative Group, 1999b, for prototype analyses). That is, we computed the same six pairwise comparisons (each treatment condition vs. the other) to trajectories of treatment response, utilizing the p value traditionally required for significance (.05) because of the exploratory nature of these analyses. For graphics, we plotted treatment response against time separately for subgroups defined on the parenting variable change score (i.e., we examined treatment patterns for families showing strong improvement in parenting practices vs. those with lesser changes in parenting practices). For contrasts in which the 3-way interaction was significant even though there was no treatment effect on the parenting variable—that is, when the parenting variable was uncorrelated with treatment—we made the interpretation that treatment moderated the effect of the process variable on the outcome of interest (Kraemer et al., 2000). Note that interaction tests in random-effects regression analyses examine the influence of a process variable on the relative effectiveness of two or more treatment conditions (e.g., does parenting influence outcome more powerfully in combined vs. unimodal treatment?). Examining the modality-specific processes underlying outcome in any one particular treatment will be the subject of subsequent MTA-related papers.

RESULTS

Data Reduction

First-order principal component analysis of the APQ revealed that a 3-factor structure accounting for 32% of

Table I. First-Order Principal Component Analysis Summary of Alabama Parenting Questionnaire ($N = 562$)

Item/Description	Loading
Factor 1: Positive involvement	
1 – Friendly talk	.59
2 – Tell good job	.74
4 – Volunteer for child's activities	.40
5 – Reward	.48
7 – Play/fun	.58
9 – Ask about school	.50
11 – Help with homework	.36
13 – Compliment	.70
14 – Ask plans	.54
15 – Drive to special activity	.34
16 – Praise	.74
18 – Hug or kiss	.64
20 – Talk about friends	.57
23 – Child plans family activities	.52
26 – Attend school meetings	.43
27 – Appreciate help	.61
Factor 2: Negative/ineffective discipline	
3 – Threaten to punish but don't	.65
8 – Child talks himself out of punishment	.56
12 – Obedience more trouble than worth	.41
22 – Let out of punishment early	.56
25 – Child not punished when misbehaves	.50
28 – Don't check on return from school	.37
29 – Don't tell child where you are going	.37
31 – Punishment depends on mood	.34
33 – Spank	.55
35 – Slap	.50
38 – Hit	.48
Factor 3: Deficient monitoring	
6 – Child fails to leave note	.63
10 – Child stays out too late	.77
17 – Child out with friends unknown to you	.61
19 – Child goes out w/o time to be home	.61
21 – Child out after dark w/o adult	.62
24 – Forget where child is	.41
30 – Child comes home 1+ hr late	.47
32 – Child home without supervision	.37

Table II. First-Order Principal Components Analysis Summary of Parent–Child Relationship Questionnaire ($N = 566$)

Item/Description	Loading
Factor 1: Positive involvement	
1 – Want to spend time with child	.31
3 – Care about each other	.42
5 – Do nice things	.65
6 – Do same things	.57
7 – Praise	.59
9 – Tell everything	.60
11 – Admire and respect child	.59
12 – Child admires/respects parent	.55
14 – Teach	.55
16 – Ask child opinion	.59
17 – Go places together	.57
19 – Explain punishment	.45
22 – Love	.42
24 – Give a hand	.58
25 – In common	.63
26 – Tell a good job	.63
28 – Shows secrets/feelings	.59
30 – Proud of child	.61
31 – Child proud of parent	.59
33 – Help	.46
35 – Listen to child before decisions	.53
36 – Play and fun	.63
38 – Give reasons for rules	.34
39 – Want child to be around always	.35
Factor 2: Negative/ineffective discipline	
4 – Disagree/quarrel	.61
8 – Order around	.63
10 – Spank	.40
13 – Deprive privileges	.49
15 – Yell	.68
18 – Make child feel ashamed	.62
23 – Mad/argue	.63
27 – Tell child what to do	.59
29 – Hit	.52
30 – Proud of child	−.31
32 – Forbid child	.51
34 – Nag or bug	.58
37 – Make child feel bad	.56
Factor 3: Intrusive involvement	
1 – Want to spend time with child	.54
2 – Restrict child out of fear	.70
20 – Want child to be with you/not others	.58
21 – Restrict out of fear of getting hurt	.69
39 – Want child to be around all the time	.61
40 – Worry about child when not at home	.73

the variance produced the most clinically interpretable pattern. See Table I for summary of factors, items, and loadings. We termed the first factor Positive Involvement (16 items, eigenvalue = 5.51, Cronbach's alpha = .85), the second factor Negative/Ineffective Discipline (11 items, eigenvalue = 3.19, alpha = .70), and the third factor Deficient Monitoring (8 items, eigenvalue = 2.37, alpha = .72). The parallel first-order principal component analysis of the PCRQ also revealed a 3-factor solution to be most readily interpretable (see Table II). This solution accounted for 37% of the PCRQ variance. The first factor (24 items, eigenvalue = 8.24, alpha = .90) measured Positive Involvement, parallel to the APQ; the second factor (13 items, eigenvalue = 4.21, alpha = .83) tapped Negative/Ineffective Discipline, also parallel to the APQ; and the third factor (6 items, eigenvalue = 2.36, alpha = .75) indexed Intrusive Involvement.

The second-order principal components analyses of these first-order factors yielded two factors with eigenvalues greater than one, which together accounted for 59%

Table III. Parenting Scores by Treatment Condition

	Negative/ineffective discipline						
	Baseline		14 month		Change		
	M	*SD*	*M*	*SD*	*M*	*SD*	*N*
Combined	.68	(1.66)	−.86	(1.76)	−1.62	(1.97)	137
MedMgt	1.03	(1.74)	−.22	(1.70)	−1.28	(1.52)	132
Behavioral	.85	(1.56)	−.42	(1.52)	−1.45	(1.94)	138
CC	.74	(1.66)	−.22	(1.61)	−.98	(1.38)	139
Total sample	.82	(1.66)	−.44	(1.67)	−1.33	(1.73)	546
	Positive/involvement						
Combined	.02	(1.80)	.33	(1.96)	.26	(1.38)	137
MedMgt	−.02	(1.81)	−.31	(1.94)	−.26	(1.55)	132
Behavioral	−.10	(1.87)	.02	(1.78)	.17	(1.52)	138
CC	.05	(1.80)	.09	(1.63)	−.02	(1.55)	139
Total sample	−.01	(1.82)	.04	(1.84)	.04	(1.51)	546

Notes. Comb = Combined; MedMgt = Medication Management; Beh = Behavioral; CC = Community Comparison.

of the variance in APQ and PCRQ scores. Factor 1 had an eigenvalue of 2.03, accounted for 34% of the variance, and was labeled Positive Involvement. It consisted of the Positive Involvement scores from both the APQ and PCRQ plus the PCRQ Intrusive Involvement score, with all loadings positive. Factor 2 had an eigenvalue of 1.48, explaining 25% of the variance; it was labeled Negative/Ineffective Discipline. The APQ Negative/Ineffective Discipline factor and the PCRQ Negative/Ineffective Discipline and Intrusive Involvement scores, all loaded positively on this factor. At this point we deleted the Intrusive Involvement first-order factor from second-order Factors 1 and 2, for two reasons. First, its positive loading on both factors reduced conceptual clarity; and second, its inclusion *reduced* the internal consistencies (alpha coefficients) of both second-order factors. After this deletion, the alphas for the second-order Positive Involvement and Negative/Ineffective Discipline factors were .92 and .83, respectively.

Parenting Factors as Change Scores

As highlighted earlier, for the second-order factor scores, we created change-score variables by subtracting baseline from 14-month scores. Thus, parenting variables refer not to absolute levels of parenting variables but rather to *change* over the course of treatment in Positive Involvement and Negative/Ineffective Discipline. For the 34 cases where data were missing at one of the assessment points, data from either 3- or 9-month assessment points were substituted and scores were prorated for time elapsed between assessments. That is, for these cases, change scores were estimated as follows: observed change × (14/number of months over which change was calculated). For an additional 33 cases, however, insufficient data were available to calculate a change score. Thus, a total of 546 scores were computed for each of the two parenting variables, which constitutes the *N* for all subsequent analyses. These 546 participants did not differ from the 33 dropped, with respect to baseline demographic or family process variables, ADHD symptoms, rates of comorbidity, or treatment assignment.

Relations Between Treatment Group and Parenting Factors

Descriptive statistics for each parenting variable, within each of the four treatment conditions, are listed in Table III. ANOVAs revealed that there were no significant differences in baseline scores for either Positive Parenting or Negative/Ineffective Discipline. The last column includes change scores; each reflects the baseline to 14-month difference between the sum of the standardized, first-order factor scores comprising each second-order factor. To ascertain whether treatment assignment influenced these parenting scores, we computed two hierarchical linear regressions in which these scores were regressed on site (the MTA was carried out at six parallel sites) and then, treatment condition (each entered as a set of dummy-coded variables). Treatment accounted for significant variance in the Positive Involvement score (R^2 change = .02, F change = 3.04, p = .03) and the Negative/Ineffective Discipline score (R^2 change = .02, F change = 3.4, p = .02) after the effects of site were considered. These

findings indicate significant (but small) effects of treatment on both positive and negative/ineffective parenting. To localize effects of treatment on the parenting variables, we performed six pairwise comparisons for each measure. For Negative/Ineffective Discipline, two of the three active MTA treatments (Comb and Beh) outperformed CC (p values $< .01$); for Positive Involvement, Comb and Beh outperformed MedMgt ($p < .01$ and $p < .05$, respectively). These are, therefore, the contrasts for which treatment was associated with change in parenting behavior. In other words, only for these contrasts could treatment effects on school-based outcome measures be mediated by parenting variables (Kraemer et al., 2000).

Relations Between Parenting Factors and Outcome

We next tested both Positive Involvement and Negative/Ineffective Discipline for potential associations with the three outcome measures: teacher-reported SNAP DB composite, SSRS Total Social Skills, and SSRS Internalizing. In our six RR equations, we entered the following main effects and interaction terms as potential predictors of response trajectories: site, treatment condition, time, parenting score, site × treatment condition, time × treatment condition, time × parenting score, treatment × parenting score, and time × treatment condition × parenting score. Crucial effects for ascertaining mediation or moderation are the interactions of time × parenting score and the 3-way interaction; their significance would signify that patterns of treatment response for the MTA conditions differ at different levels of the parenting variable.

For Positive Involvement, the crucial interactions were not significant for any of the three outcomes. For Negative/Ineffective Discipline, however, the 3-way interaction was significant for two outcomes: the teacher SNAP DB scale, $F(3, 655) = 4.00$, $p < .01$, and the teacher SSRS Total Social Skills scale, $F(3, 651) = 3.08$, $p < .05$. Such patterns of interaction indicate that patterns of treatment response for the MTA conditions differ at different levels of Negative/Ineffective Discipline. To isolate the source of these interactions, we calculated the interaction term for all possible pairwise contrasts among the four MTA treatments (Comb vs. MedMgt, Comb vs. Beh, Comb vs. CC, MedMgt vs. Beh, MedMgt vs. CC, Beh vs. CC).

For the teacher SNAP DB score, the only significant contrast pertained to Comb versus Beh (Wald = 3.44, $p < .01$). Figure 1 graphically displays this finding. In the figure panels, three Negative/Ineffective Discipline subgroups were defined as follows: (a) scores $\frac{1}{2}$ standard deviation or more beyond the mean change score in the direction of greater reduction ($n = 134$; Comb = 40, MedMgt = 31, Beh = 40, CC = 23), signifying families with the most marked reductions in negative/ineffective disciplinary practices; (b) scores within $\frac{1}{2}$ standard deviation of the mean change score ($n = 253$; Comb = 68, MedMgt = 62, Beh = 58, CC = 65), demarcating families whose negative/ineffective discipline mildly decreased; and (c) scores $\frac{1}{2}$ standard deviation or more beyond the mean change score in the direction of less reduction, reflecting parents whose self-reported negative/ineffective discipline practices stayed level or actually increased over the course of treatment ($n = 159$; Comb = 29, MedMgt = 39, Beh = 40; CC = 51). As can be seen, change in DB outcomes between Comb and Beh conditions varied as a function of the degree of reduction in Negative/Ineffective Discipline. When Negative/Ineffective Discipline improved most dramatically (see Fig. 1, panel a), the relative benefit (in terms of decreased child disruptive behavior) of Comb in relation to Beh was markedly stronger than when Negative/Ineffective Discipline showed only moderate improvement or showed no improvement at all (panels b and c). Thus, Comb was most differentiable from Beh when parents showed clear decreases in Negative/Ineffective Discipline.

Note that, in Fig. 1 (panel a), the end-of-treatment score for the Comb participants showing the greatest reductions Negative/Ineffective discipline was approximately 0.7, a score within the normal range for the SNAP instrument (Swanson, 1992). Thus, the Comb effects in this subgroup were clinically as well as statistically meaningful, in that when Comb families showed strong reductions in Negative/Ineffective Discipline, their children's disruptive behavior at school was in the normal range, well below the "excellent response" criterion of 1.0 ("just a little" of the symptoms) discussed by Swanson et al. (in press).

We cannot, however, interpret this intriguing pattern as a mediator effect, because in the first step of evaluating such effects (does treatment influence the putative mediator variable?), the specific contrast of Comb versus Beh did not attain significance, that is, this contrast did not reveal improvement in Negative/Ineffective Discipline. Thus, we interpret the significant interaction as indicating that treatment assignment *moderated* the relationship between Negative/Ineffective Discipline and reduced disruptive behavior at school (Kraemer et al., 2000). That is, for the Comb condition, reduced parental Negative/Ineffective Discipline was associated with improvement in disruptive behavior; but such a relationship was not obtained for Beh.

For SSRS Total Social Skills, two contrasts were significant: Comb versus Beh (Wald = 1.98, $p < .05$) and

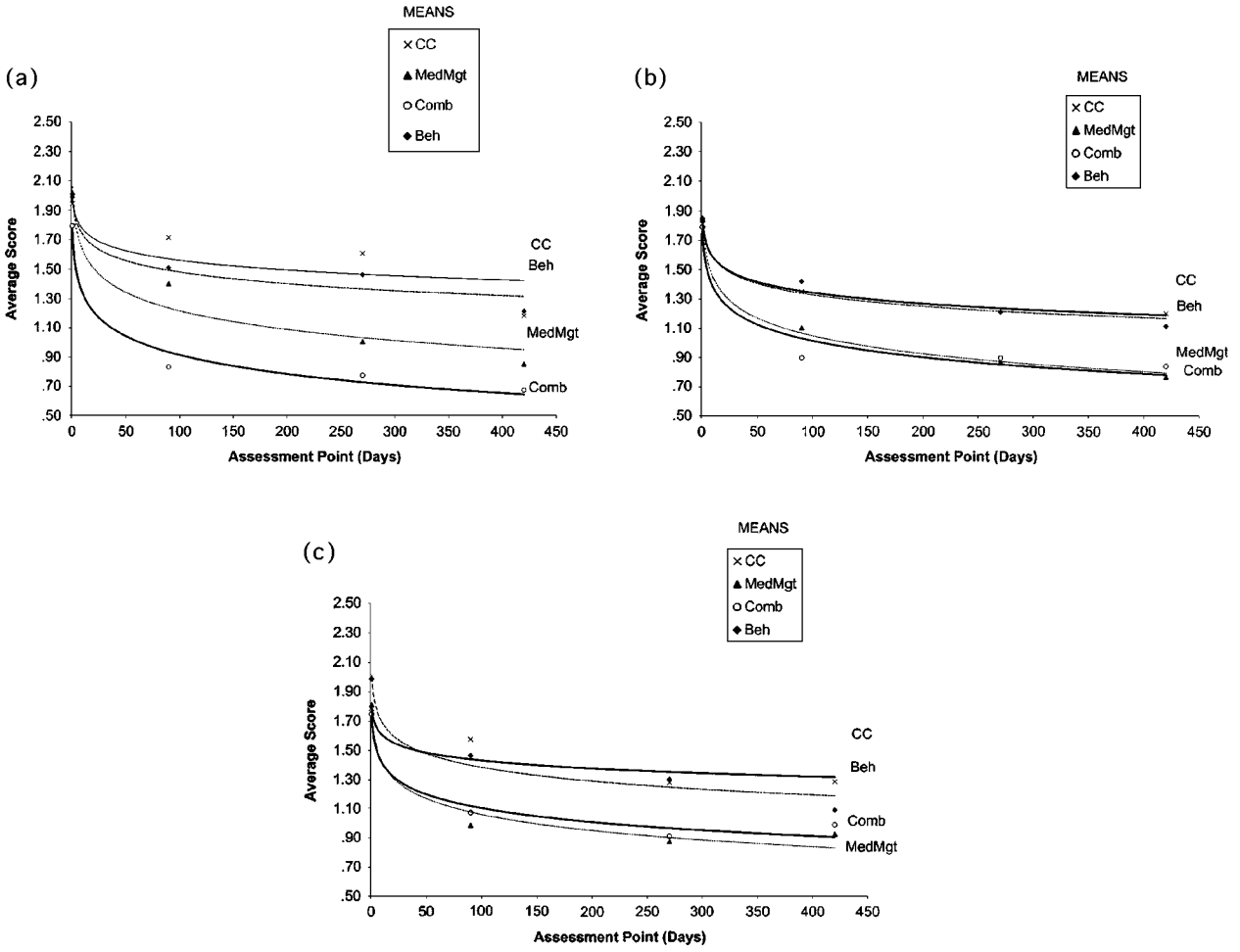

Fig. 1. Changes across 14 months of MTA intervention for teacher SNAP Disruptive Behavior (DB) scores: (a) in families showing the greatest decrease in Negative/Ineffective Discipline, (b) in families showing moderate decrease in Negative/Ineffective Discipline, and (c) in families showing minor decrease or increase in Negative/Ineffective Discipline.

Comb versus CC (Wald = 2.85, $p < .01$). Figure 2 graphically displays these findings. Parallel to the teacher DB scores, when Negative/Ineffective Discipline showed the strongest decreases, the relative benefit (in terms of improved child social skills) of both Comb over Beh and Comb over CC was largest. (For this measure of social skills, higher scores reflect greater improvement.) We interpret the former contrast similarly as the parallel contrast just described for DB scores: In Comb (but not in Beh), reductions in parental Negative/Ineffective Discipline were associated with increases in teacher-reported social skills; treatment assignment moderated the relationship between parenting change and disruptive outcomes. For the Comb versus CC contrast, however, the full set of conditions for establishing a mediator effect was revealed. Specifically, this contrast produced a significant effect on Negative/Ineffective Discipline and yielded a significant interaction with Negative/Ineffective Discipline on the trajectory of response related to Total Social Skills. In short, the synergistic effects of medication plus behavioral treatment in enhancing teacher-reported social skills, relative to community treatment, were explainable (mediated) by reductions in negative and ineffective parenting practices induced by the Comb condition.

DISCUSSION

Our goal was to extend the primary *outcome* results from the MTA (MTA Cooperative Group, 1999a, 1999b) by exploring relevant *processes* that may underlie or mediate behavior change. Specifically, we examined changes in parenting practices as potential explanatory factors of teacher-reported outcomes in the domains of

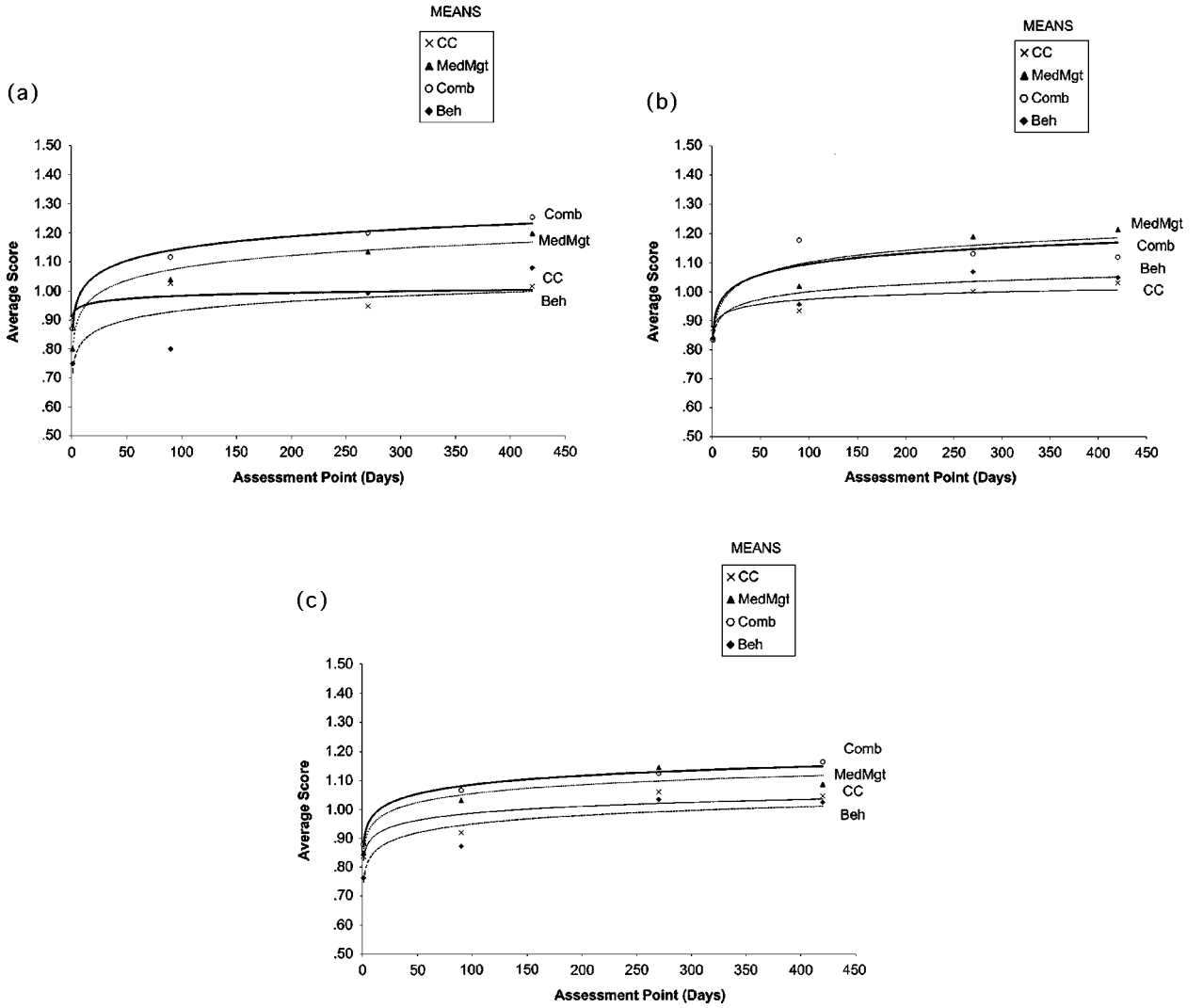

Fig. 2. Changes across 14 months of MTA intervention for teacher SSRS Total Social Skill scores: (a) in families showing the greatest decrease in Negative/Ineffective Discipline, (b) in families showing moderate decrease in Negative/Ineffective Discipline, and (c) in families showing minor decrease or increase in Negative/Ineffective Discipline.

disruptive behavior, social skills, and internalizing symptomatology. Although our factor analyses uncovered two robust second-order dimensions of parenting behavior (Positive Involvement and Negative/Ineffective Discipline), interactive effects were found only for the latter. Regarding the contrast of Comb versus CC, (a) the MTA treatments produced significant decreases in the Negative/Ineffective Discipline factor (see also Wells et al., this issue-a); and (b) changes in Negative/Ineffective Discipline were associated with improvements in teacher-reported social skills. Thus, when pharmacologic and behavioral treatments were paired in the Comb condition, benefits for the child's social functioning (over and above those in regular community care) were at least partially mediated by parental reductions in Negative/Ineffective Discipline. For the contrast of Comb versus Beh, regarding both DB and Total Social Skills outcome, we found that treatment condition moderated the effect of Negative/Ineffective Discipline on reducing school-based disruptive behavior and enhancing classroom social skills. Specifically, in families showing the greatest reductions in self-reported negative and ineffective disciplinary practices, the superiority of Comb over Beh was most pronounced for these developmentally important outcomes (e.g., Parker & Asher, 1987), even though the Comb–Beh contrast did not significantly influence the negative

and ineffective parenting practices per se. We did not uncover any mediator or moderator effects for the outcome of teacher-reported internalizing symptoms, for which overall treatment effects were far smaller in the first place (MTA Cooperative Group, 1999a).

Although we hypothesized that any "explanation" of MTA treatment outcomes via parenting variables would be most prominent for the behavioral component of intervention, which explicitly targeted parenting skills in an intensive, carefully manualized, empirically based treatment strategy (Wells et al., this issue-b), we found that it was *combination* treatment that revealed the key moderator and mediator effects. Specifically, when careful medication management strategies were added to intensive behavioral treatment, enhanced outcome for positive social skills at school was mediated by reduced Negative/Ineffective Discipline at home; and Combination treatment influenced the ways in which Negative/Ineffective Discipline was associated with reductions in school-based disruptive behavior. Thus, the effects of pharmacologic intervention added to behavioral therapy were at least partially explained by psychological processes regarding the parent-child relationship. Indeed, the field is now beginning to appreciate that interventions of a "biological" nature may well exert their effects via "psychological" means and vice versa (e.g., Baxter et al., 1992).

Indeed, two decades of acute treatment research have shown that giving stimulant medication to children with ADHD quickly induces reductions in parental harshness and control (e.g., Barkley & Cunningham, 1979). What is unique about the current findings is that medication-related reduction of parental negative/ineffective discipline (when paired with behavior therapy in the Comb condition) was associated with, in turn, longer-term and generalized improvements in the child's behavioral and social functioning at school. Clinically, such findings are not surprising: Stimulant medications alter the child's abrasive behavioral style, leading to a consequent "easing up" of harsh discipline by parents. This disciplinary change may help the child to achieve greater self-regulation, effecting improved school behavior. Yet changes in parenting without the benefits of medication do not, apparently, lead to such generalized behavioral change.

Although the MTA is a randomized clinical trial, it is conceivable that "third variables" related to Comb treatment procedures (e.g., changed parental expectations) could have produced both reductions in negative/ineffective discipline and improvements in children's social functioning at school. It is also quite possible that the causal arrow could be reversed: Improvements in disruptive behavior at school (quickly facilitated by the medication component or the school consultation component of combined treatment) may enable families to relax harsh discipline at home (for example, regarding homework), especially when the parent training procedures of combined treatment are being implemented. Indeed, subsequent investigations might focus on more precise temporal specification: Do early changes in child behavior (via medication) predict quick reductions in parental negative discipline, which then predict subsequent improvements in school-related outcomes? Or, do early changes in school-related behavior allow parents to relinquish some of their negative disciplinary practices? In all, despite the randomized, experimental nature of the MTA trial, tests for mediator and moderator variables involve ascertaining *associations* between changes in parenting scores and outcome measures, leaving indeterminate the causal ordering of the putative mediational results.

Our findings are noteworthy in suggesting that a key mechanism underlying school-based improvements in child functioning involves enhancement of parental discipline strategies at home. In this regard, we note that (a) the behavioral component of Comb included a daily report card contingency system, designed to foster integration between home and school programming; and (b) pharmacotherapists administering medications for the medication-related component of Comb were required to stay in monthly contact with both parents and teachers. Thus, our treatment procedures emphasized cross-setting coordination and generalization.

Strengths of the study include its large sample size, the relatively long-term nature of the interventions that were delivered, and the experimental assignment of participants to treatment. As argued recently, experimental clinical trials are markedly underutilized for their potential to make causal inferences regarding important etiologic and maintaining factors in developmental psychopathology (Hinshaw & Park, 1999). We reiterate the amenability of clinical trials to conceptual analysis of causal processes (see Conduct Problems Prevention Research Group, 1997; Vitaro et al., 1999). In addition, we highlight the clinical significance of our findings with respect to school-reported disruptive behavior, in that the end-of-treatment DB score for the subgroup of Comb participants showing the greatest reductions in Negative/Ineffective discipline was well within the normative range for children this age, meeting the criterion for "excellent response" (i.e., SNAP score < 1.0) utilized in other MTA analyses (see Swanson et al., in press).

Limitations involve the earlier-noted causal indeterminacy of the mediator relationships, the lack of longer-term follow up to monitor the extensiveness of the

treatment-related gains (and pertinent mediator or moderator effects), and the lack of objectively measured indicators of parenting style in our analyses. Furthermore, by utilizing a teacher report of internalizing symptoms, we may have not included an optimal informant for assessing this key outcome domain.

It is conceivable that our moderator and mediator effects could themselves be moderated by the comorbid status of MTA participants. Specifically, it may be the case that reductions in Negative/Ineffective Discipline are associated with school-based treatment outcomes only or chiefly for ADHD children with significant disruptive behavior patterns (e.g., those with comorbid ODD/CD). In partial support of this contention, the percent of children with comorbid ODD/CD was largest in families who reported the greatest reductions in Negative/Ineffective Discipline (66%, vs. 59% and 51% in the moderate-decrease and no-change groups, respectively). Exploratory subgroup analyses, however, revealed that our main results for children without comorbid ODD/CD were quite similar to those for the whole sample. We also reconducted our primary analyses separately for SNAP subscales reflecting ADHD symptoms versus ODD symptoms. In each case, the same Comb versus Beh contrast was significant, indicating quite similar patterns of findings for ADHD and ODD symptomatology. In short, it appears that our results were not "carried by" the subgroup of children with ADHD and disruptive behavior problems but rather apply to the entire sample.

We note also that familial receipt of public assistance in the MTA moderated treatment response for families receiving MedMgt alone (MTA Cooperative Group, 1999b), in that these families reduced positive interactions with their children across the trial. The present results suggest that combining active, intensive behavioral treatment with medication may reverse this trend; but analysis of moderator effects in this domain awaits further investigation. Note, however, that despite the large sample size of the MTA trial, analyzing combinations of moderators and mediators quickly reduces cell sizes, constraining statistical power.

Our report provides unprecedented data regarding parenting processes in explaining the effects of combined mediation-behavioral treatments on crucial school-related outcomes. Our data suggest that effective reductions of power-assertive, harsh, and inconsistent/ineffective disciplinary practices relate to important changes in disruptive behavior patterns and social skills in the school setting. They also provide a warning to those who artificially separate pharmacologic from psychosocial treatments, at both clinical and conceptual level. Indeed, the field has only recently begun to appreciate the complexity of the interrelationships and integrations between such "levels" and types of interventions.

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