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The Relationship of Parental Warm Responsiveness and Negativity to Emerging Behavior Problems Following Traumatic Brain Injury in Young Children

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Abstract

Parenting behaviors play a critical role in the child's behavioral development, particularly for children with neurological deficits. This study examined the relationship of parental warm responsiveness and negativity to changes in behavior following traumatic brain injury (TBI) in young children relative to an age-matched cohort of children with orthopedic injuries (OI). It was hypothesized that responsive parenting would buffer the adverse effects of TBI on child behavior, whereas parental negativity would exacerbate these effects. Children, ages 3–7 years, hospitalized for TBI (n = 80) or OI (n = 113), were seen acutely and again 6 months later. Parent–child dyads were videotaped during free play. Parents completed behavior ratings (Child Behavior Checklist; T. M. Achenbach & L. A. Rescorla, 2001) at both visits, with baseline ratings reflecting preinjury behavior. Hypotheses were tested using multiple regression, with preinjury behavior ratings, race, income, child IQ, family functioning, and acute parental distress serving as covariates. Parental responsiveness and negativity had stronger associations with emerging externalizing behaviors and attention-deficit/hyperactivity disorder symptoms among children with severe TBI. Findings suggest that parenting quality may facilitate or impede behavioral recovery following early TBI. Interventions that increase positive parenting may partially ameliorate emerging behavior problems.

Keywords

brain injury; parent–child interactions; externalizing behavior; responsiveness; negativity

The Behavioral Consequences of Childhood Traumatic Brain Injury (TBI)

TBI is a leading cause of death and disability in childhood, resulting in 435,000 emergency room visits and 37,000 hospitalizations annually (Langlois, Rutland-Brown, & Thomas, 2006). Epidemiological evidence indicates that young children (under age 5 years) may be at

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greater risk of injuries requiring emergency treatment or hospitalization than are older children (Langlois et al., 2006), underscoring the importance of understanding and reducing morbidity in this age range.

The effects of childhood TBI are varied and profound, affecting all aspects of child functioning (Yeates, 2010). The majority of children with moderate to severe injuries experience at least transient cognitive and behavioral impairment (Anderson et al., 2006; Yeates et al., 2002). Academic achievement, school performance, and adaptive abilities are also impaired (Ewing-Cobbs et al., 2004, 2006). However, behavioral changes and emerging behavior problems represent the most persistent consequence of TBI in children (Rutter, Chadwick, Shaffer, & Brown, 1980). Existing evidence suggests that significant behavior problems develop in 10% to 21% of children with a mild TBI and in 62% to 71% of children with a severe TBI (Fay et al., 1994; Fletcher, Ewing-Cobbs, Miner, Levin, & Eisenberg, 1990; Schwartz et al., 2003), underscoring the importance of social and behavioral outcomes following TBI. Depending on the length of follow-up and the criteria for identifying disorder, between 67% and 78% of new behavioral disorders emerge within the first 6 months following injury, suggesting that this is a critical period for identifying social environmental factors that influence the emergence of new problems (Max, Lindgren, et al., 1997; Max, Robin, et al., 1997).

Most previous studies have focused on the behavioral consequences of TBI in school-age children. However, existing data suggest that TBI in a young child may result in potentially more severe sequelae than is the case for older children (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2000; Anderson & Moore, 1995). Specifically, children aged 2–7 years at the time of injury are more susceptible to deficits in expressive language, attention, executive function skills, and academic achievement and show less recovery of intelligence quotient (IQ) compared with children injured at later ages (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2005; Barnes, Dennis, & Wilkinson, 1999; Dennis, Wilkinson, Koski, & Humphreys, 1995; Ewing-Cobbs et al., 1997; Ewing-Cobbs, Miner, Fletcher, & Levin, 1989; Verger et al., 2000). Although the reasons for poorer outcomes in younger children are unclear, investigators have speculated that less localized brain–behavior relationships in young children may result in a greater susceptibility to diffuse brain insult, whereas others have posited greater effects of injury on emerging skills (Anderson & Moore, 1995; Barnes et al., 1999; Ewing-Cobbs et al., 2004; Taylor & Alden, 1997).

Emerging behavior problems following pediatric TBI cut across diagnostic categories and are often characterized by dysregulation, increased impulsivity, and affective lability (Bloom et al., 2001; Max et al., 2000; Max, Robin, et al., 1997). Secondary attention-deficit/hyperactivity disorder (ADHD) is a frequent diagnosis (Max et al., 2005a, 2005b). Anxiety symptoms are also common, particularly among children with injuries not involving the frontal lobes (Vasa et al., 2002).

Social-Environmental Influences on Recovery

Beyond injury severity, preinjury developmental or behavior concerns and less advantaged family environments have been linked to elevated levels of postinjury behavior problems (Kinsella, Ong, Murtagh, Prior, & Sawyer, 1999; Max, Lindgren, et al., 1997; Max, Robin, et al., 1997; Taylor et al., 1999; Yeates et al., 1997, 2004). However, few investigators have considered the role of proximal social environmental factors, such as parenting behaviors, in recovery from TBI in young children. Given the central role of parent and family characteristics, such as the degree of parental warmth and responsiveness, in a typically developing child's social, emotional, and cognitive development (Bradley, Corwyn,

Burchinal, McAdoo, & Garcia Coll, 2001), it is critical to clarify their relationship to recovery after early TBI.

With respect to school-age children, a growing body of literature has demonstrated that social factors, such as socioeconomic status (SES), family functioning, and interpersonal stresses, and resources influence recovery post TBI (Kinsella et al., 1999; Max, Lindgren, et al., 1997; Max, Robin, et al., 1997; Taylor et al., 2002; Yeates et al., 2004). Findings from some of these studies suggest that the effects of the social environment are amplified following severe TBI, with the greatest effects on the child's social and behavioral functioning (Taylor et al., 2002; Yeates et al., 2004). Emerging behavior problems, in turn, adversely influence postinjury family functioning, contributing to greater dysfunction. These studies provide evidence for reciprocal influences between child recovery and family adaptation over time after pediatric TBI (Taylor et al., 2001). Unfortunately, previous investigations have been largely limited to parent-report measures of the social environment (see Wade et al., 2003, for an exception) and have failed to examine the relationship of observed environmental characteristics to the emergence of behavior problems following TBI in young children.

The Importance of Parental Responsiveness and Criticism to Emerging Behavior Problems

Developmental psychopathology research has focused on two broad domains of parenting behaviors: (a) positive parenting qualities, such as warmth, responsiveness, and synchrony, and (b) harsh or negative parenting marked by criticism and punitive discipline. Positive parenting behaviors have been shown to contribute to emerging behavior regulation and social competence and a reduced incidence of externalizing behavior problems (Bradley & Corwyn, 2007; Rothbaum & Weisz, 1994). Conversely, parental negativity, harshness, and criticism have been linked to poorer self-regulation and greater behavior problems over time (Ackerman, Brown, & Izard, 2003; Deater-Deckard, Dodge, Bates, & Pettit, 1998; Deater-Deckard, Ivy, & Petrill, 2006; Rubin, Burgess, Dwyer, & Hastings, 2003; Shaw, Gilliom, Ingoldsby, & Nagin, 2003). Evidence suggests that both positive and negative parenting behaviors may exert a greater influence on externalizing than internalizing behaviors (Rothbaum & Weisz, 1994). Moreover, the effects of parenting on child behavior may vary as a function of caregiver and child characteristics (Rothbaum & Weisz, 1994). Children at biological risk may be more sensitive to the effects of both positive and adverse parenting qualities. For example, Landry, Smith, Miller-Loncar, and Swank (1997) found that the relationship between maternal maintaining behaviors and child initiating behaviors was stronger among very low-birth-weight children than among full-term children. More significantly, maternal behaviors, such as restrictiveness, had a stronger relationship to subsequent development among low-birth-weight toddlers than among full-term toddlers, with greater maternal restrictiveness contributing to slower development (Landry et al., 1997). Therefore, consideration of the moderating effects of specific parent–child interactions is critical to an understanding of environmental influences on the emergence of child behavior problems following early TBI.

Overview of the Present Study

The present investigation builds upon a previous report of parent–child interactions during the initial weeks following early childhood TBI and OI (Wade et al., 2008). In this previous report, we noted that parents of children with TBI exhibited less warm responsiveness and made more directive statements during a structured task than did parents in the OI group, although parenting behaviors did not differ during free play. In addition, parental warm-responsiveness was more strongly related to child cooperativeness in the OI group than the

TBI group, suggesting a disconnection between child behaviors and parental responsiveness following TBI.

In the current study, we sought to examine the relationship of observed parenting behaviors both shortly after the injury and approximately 6 months later to the development of behavior problems in young children with TBI compared with children hospitalized for orthopedic injuries (OI). Levels of preinjury behavioral problems, as assessed at baseline, were included as covariates in each of the analyses to allow us to examine parenting behaviors in relation to changes in behavior problems following injury. We hypothesized that positive parenting behaviors, as defined by parental warmth and responsiveness, would be associated with lower levels of new behavior problems, as assessed by parent ratings at the 6-month assessment, with stronger associations following severe TBI (moderating model). Conversely, we hypothesized that parental negativity and criticism would be associated with higher levels of new behavior problems, particularly in the context of severe TBI. Because attention problems and secondary attention-deficit disorder occur commonly after TBI (Max et al., 2005a, 2005b), we examined the relationship of observed parenting behaviors to emerging ADHD symptoms as well as externalizing and internalizing problems. On the basis of previous research, we hypothesized that associations between parenting behaviors, both positive and negative, and child behavior problems would be more evident for externalizing and ADHD symptoms than for internalizing symptoms. As among the first investigations to examine parent–child interactions following pediatric TBI, this study provides important new information about the role of parenting behaviors in acute recovery following early TBI.

Method

The study used a prospective, concurrent cohort research design to assess young children with TBI and young children with OI and their families shortly after the injury and again 6 months later. Poorly regulated child behavior and family characteristics, such as the degree of parental supervision and monitoring, have been shown to contribute to the risk for injury (both TBI and OI) and may also relate to preinjury parent–child interactions (Goldstrohm & Arffa, 2005). Thus, use of an OI comparison group increases the likelihood that the groups are comparable in terms of preinjury impulsivity and family functioning, factors that are also likely to be associated with postinjury behavior difficulties (Max et al., 2005a, 2005b). The study was approved by the Institutional Review Boards at each of the participating medical centers, and informed consent was obtained from participating caregivers.

Recruitment Criteria

Consecutive admissions of children with TBI or with OI not involving the central nervous system (CNS) were screened at three tertiary care children's hospitals and a general hospital (all with Level 1 trauma centers) in Ohio. Eligibility requirements for both groups included age between 36 to 84 months at the time of injury and English as the primary spoken language in the home. Eligibility for the TBI group also included a TBI requiring overnight admission to the hospital with a Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974) score of 12 or less or a higher score accompanied by evidence of abnormalities on neuroimaging (magnetic resonance imaging [MRI] or computed tomography [CT] scan). Children with nonblunt head trauma (e.g., projectile wounds, strokes, drowning) were excluded. Inclusion in the OI group required a documented bone fracture (other than the skull), an overnight hospital stay, and the absence of any evidence of loss of consciousness or other findings suggestive of brain injury (e.g., symptoms of concussion). Parents of all children meeting these criteria were contacted either during the child's hospital stay or subsequently by letter and follow-up phone calls to conduct further screening and recruit the family for participation. As part of the recruitment screening procedure, children were

excluded if they had any of the following: previous history of brain injury; preexisting neurological disorder or medical problem affecting the CNS; diagnosis of mental retardation, autism, or neurological disorder; documentation in the medical chart or in the parent interview of child abuse as the cause of injury or history of severe psychiatric disorder requiring hospitalization.

Sample Characteristics

A total of 206 children and their caregivers (87 with TBI and 119 with OI) completed informed consent and were enrolled in the study. Baseline data were collected on 204 children and caregivers (87 with TBI and 117 with OI). The sample included 54% of eligible children with TBI and 35% of eligible children with OI. Comparison of enrolled children with those in the Trauma Registry at participating hospitals meeting age and injury severity criteria indicated that our sample was representative of all eligible children in terms of race and family income (based on median income from the 2005 Census for the child's address). All but six children (95%) completed the videotaped interaction tasks at the baseline assessment, and an additional four children had unusable videotapes and were thus excluded from the analyses (see Wade et al., 2008, for a more complete description of the baseline sample). The primary caregiver was the child's mother in all but eight families (96%). In these families, fathers (three), grandmothers (four), or permanent legal guardians (one) served as the primary caregiver and completed the parent–child interaction task. Eighty-four percent of the original sample completed the 6-month follow-up assessment. Those who did not complete the follow-up did not differ significantly from completers with respect to type and severity of injury, age at injury, race, child sex, or on a composite measure of family income and education. Completers and noncompleters were also comparable with respect to observer and parent ratings of child and parent behaviors at baseline (all ps > .10; see Table 1). Using the program SOLAS for Missing Data (Statistical Solutions, 2001), data missing at baseline for completers were imputed using the age at injury, race, and gender as covariates in the model.

Tables 2 and 3 present the characteristics of the children who completed the assessments at both baseline and the 6-month follow-up. Consistent with previous investigations (Fletcher et al., 1990), severe TBI was defined as injury resulting in a GCS score of 8 or less at any point since injury and moderate TBI was defined as a GCS score of 9–12 or a higher GCS score accompanied by evidence of brain insult on neuroimaging (CT or MRI). Children in both TBI groups were hospitalized longer than children with OI, and children with severe TBI were hospitalized longer than children in the moderate TBI group. The time between injury and baseline assessment was longer for the TBI group (M = 49.90 days, SD = 35.35) than for the OI group (M = 35.40 days, SD = 14.89), $t(1, 176) = 110.12$, $p < .000$, because of difficulties recruiting and testing the children acutely following TBI.

As reported previously (Wade et al., 2008), the groups did not differ from each other with respect to preinjury delays in growth and development, learning difficulties, or problems with emotions and behavior, suggesting that these children had comparable rates of developmental and behavioral concerns prior to the injury. Rates of rehospitalization during the initial 6 months post injury were uniformly low, with 0% severe TBI, 2% of the moderate TBI, and 4% of the OI group experiencing a subsequent hospital admission. Thirty-seven percent of the children in the severe TBI group, 20% of those in the moderate TBI group, and 21% of those in the OI group received counseling after their injury, and this difference was not statistically significant. The groups did not differ in the proportion of non-Caucasian parents, but there were trends for differences in family income and parental education. To control for the possible influence of demographic factors on observed parent and child behaviors, race and a composite z score of parental education and median census

tract income were included as covariates in all analyses. Participation in counseling was also included in the preliminary models to control for its effects on the outcomes of interest.

Procedures

Observations of parent and child behaviors during videotaped interactions were conducted shortly after the injury at the baseline assessment and again at 6 months after the baseline assessment. Parent ratings of child behavior problems prior to the injury were also collected at the baseline evaluation; the parent ratings were repeated at 6 months to assess postinjury behavior problems. The present report examines the relationship of ratings of parental warm responsiveness and negativity at the initial and 6-month assessments to changes in child behavior problems over this period, after controlling for preinjury levels.

Measures

Ratings of parent behavior—We videotaped the parent–child dyad while engaged in unstructured free play. During the 10-min free play interaction, the parent was instructed to spend time with his/her child as if they were at home. The room was equipped with developmentally appropriate toys as well as magazines for the parents to read. The play portion was divided into two 5-min segments for rating purposes and transcribed to facilitate coding of caregiver and child verbalizations.

To rate parent and child behaviors, we employed the coding system used by Landry et al. (1997) in their studies of outcomes in low-birth-weight children. This system incorporates ratings of parent and child behaviors that reflect more enduring dispositions or interactive styles (Bakeman & Brown, 1980). Considerable support exists regarding the predictive validity of these ratings for subsequent child cognitive and social development (Landry, Miller-Loncar, Smith, & Swank, 2002; Landry et al., 1997; Landry, Smith, Swank, Assel, & Vellet, 2001). Parent behavior was coded along the dimensions of warmth, contingent responsiveness, and negativity. Each dimension was rated along a 5-point scale, with higher scores indicating more positive behavior (i.e., high warmth, minimal negativity). *Parental warmth* was rated on the basis of the presence and intensity of verbal and nonverbal warmth, affection, and positive regard toward the child. *Contingent responsiveness* ratings reflected the degree of the parent's sensitivity and responsiveness to the child's behavior (see Wade et al., 2008, for a more complete description). *Negativity* was rated on the basis of the presence of a harsh or angry tone of voice, sarcasm and demeaning comments, physical control such as slaps or pinches, and physical expressions of impatience (eye-rolling, sighing). Coders also rated the child's *behavioral regulation*. As with the caregiver ratings, child ratings were based on a 5-point scale, with higher ratings reflecting more socially appropriate behavior (i.e., better behavior regulation).

Each 5-min segment was coded independently, with ratings for the two play segments subsequently averaged, thereby increasing the stability of our measures. To assess inter-rater reliability, 15% of the tapes were rated by the entire rating team. Each rater's reliability with the group ratings was assessed using intraclass correlation coefficients (ICC). ICCs for all codes and raters were .8 or greater (range = .80–.99) indicating a high level of inter-rater reliability. Although raters were not informed of the group status of parent–child dyads, some children in both groups had casts indicative of orthopedic injuries, and some children with severe TBI had visible speech or motor impairments associated with their injuries at the baseline assessments. Therefore, complete concealment of injury status was not possible among the raters.

Scales with correlations exceeding .75 were averaged to form composites. Based on this criterion, warmth and contingent responsiveness were averaged into a single scale of “warm

responsiveness" reflecting positive parenting behavior (see also Landry, Smith, & Swank, 2006). The lack of parental negativity was not highly correlated with positive parenting behaviors (r = .28–.31) and was thus retained as a separate scale.

Assessment of child behavior problems—Parents completed the age-appropriate form of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) at baseline and 6 months postinjury. The CBCL is a commonly used parent-report measure of child behavior problems and possesses high test–retest reliability and criterion-related validity. At baseline, parents were asked to complete the CBCL based on the child's preinjury behaviors. T scores for the Internalizing Behavior Problem Scale, the Externalizing Behavior Problem Scale, and the Attention-Deficit/Hyperactivity (ADHD) Scale provided indices of the behaviors that were anticipated to worsen as a consequence of TBI (Bloom et al., 2001; Max et al., 2005a, 2005b; Vasa et al., 2002). The ADHD Scale contains items assessing common symptoms of ADHD, including difficulties with concentration, sitting still, impulsiveness, and inattention. Correlations among the scales considered in this study ranged from .51 (between Internalizing and ADHD) to .79 (between Externalizing and ADHD). As in previous studies (Schwartz et al., 2003), a clinical cutoff score of T = 63 was used to identify clinically significant behavior problems. This T score corresponds to ratings obtained by less than 10% of the normative sample. Table 4 reports the proportion of children in each group exceeding the clinical cutoffs on the CBCL.

Child intellectual functioning—The General Conceptual Ability (GCA) index from the Differential Ability Scales (DAS; Elliott, 1990) provided an overall index of cognitive functioning, allowing us to statistically control for the effects of IQ on parenting and child behavior problems. The DAS was administered as part of the baseline assessment. The GCA is a standard score composite of subtests of language abilities, reasoning, and processing speed/visual search.

Parent and family functioning—Caregiver psychological distress at baseline was measured using Brief Symptom Inventory (BSI; Derogatis & Spencer, 1982), a 53-item questionnaire tapping a wide range of psychological symptoms. Reliability and validity are well established. Overall parent distress on this measure was summarized using the General Severity Index (GSI).

The 12-item General Functioning Scale (GF) of the Family Assessment Device (FAD; Miller, Bishop, Epstein, & Keitner, 1985) was administered to assess global preinjury family functioning at baseline and current functioning at the follow-up assessments. The FAD-GF has demonstrated reliability and validity and correlates highly with other FAD subscales. Higher scores on the FAD-GF indicate greater family dysfunction. These measures were included to allow us to statistically control for the effects of caregiver distress and family functioning when examining the relationship between parenting behaviors and child behavior problems.

Analyses

We conducted separate general linear regression analyses to examine the relationships of (a) parental warm responsiveness and (b) negativity to child behavior (internalizing, externalizing, and ADHD scales from the CBCL and observed regulation) at 6 months postinjury. Ratings of parenting behaviors from the baseline and 6-month assessments were analyzed separately to provide information with regard to both predictive and concurrent associations of parent measures with child behavior problems. The TBI injury group was divided into a moderate and severe group on the basis of the severity of injury, with the OI group serving as a reference category. Dummy coding was used to contrast the moderate and

severe TBI groups with the OI reference group. Interaction terms were created to allow us to examine whether the relationship of parenting behavior to child behavior problems varied as function of the nature and severity of the injury (moderation hypothesis).

Variables on which the groups differed or which may have significant associations with both parenting and behavior problems were examined in preliminary analyses. Time between injury and baseline assessment was significantly longer following TBI than OI. However, it was unrelated to ratings of parenting or pre- or postinjury ratings of child behavior and thus dropped from the multivariate models. The receipt of counseling or other therapies was also examined in light of its potential contribution to subsequent child behavioral functioning but was also subsequently dropped from multivariate models because of its lack of association with any of the outcome variables. As indicated in Table 2, there were trends for group differences in SES. To address this potential confound, race and a *z* score combining maternal education and family income were included as covariates in all analyses. Other factors that were likely to influence the emergence of child behavior problems following early TBI, such as the child's cognitive functioning, parental psychological distress, and overall family functioning, were included as potential predictors in each of the analyses. Race and SES were retained in all models; however, other variables that were not significant ($p < .05$) were trimmed from the final models.

Using generalized linear modeling, unstandardized correlation coefficients, standard error terms, and probabilities were calculated for each model and presented in Table 5. Because statistical interactions can be difficult to detect (McClelland & Judd, 1993), alpha was set at .05, rather than adjusting the level for multiple comparisons. The standardized coefficient was calculated to provide an estimate of effect sizes. Analyses were conducted using SAS Version 9.2 (SAS, Inc., Cary, NC).

Results

Group Differences in Parental Warm Responsiveness and Negativity Over Time

As reported in Table 3, ratings of warmth differed significantly by group with parents of children with OI rated as displaying greater warm responsiveness than parents in the moderate TBI group. Ratings of warm responsiveness declined significantly over time, with the Group × Time interaction approaching significance ($p = .08$). Inspection of this interaction revealed that ratings of warm responsiveness declined in the severe TBI and OI groups but remaining unchanged in the moderate TBI group. Ratings of negativity were highly skewed, with less than 10% of parents receiving ratings of less than 4 (slightly negative). As a result, a dichotomous measure of negativity (some vs. none) during play was used as the predictor in the analyses. Fifty-one caregivers were rated as displaying some negativity during free play at Visit 1 (28.5%) versus 37 at Visit 2 (20.7%); however, ratings of parental negativity did not differ by group or time.

The Relationship of Caregiver Distress, Family Functioning, and IQ to Child Behavior

Caregiver distress, as assessed by the BSI-GSI, was a significant predictor of both internalizing and externalizing symptoms on the CBCL at 6 months postinjury; the corresponding effect sizes were small (<.20). Family dysfunction, as assessed by the FAD-GF, was also predictive of internalizing symptoms at 6 months. In both cases, higher levels of parent/family dysfunction corresponded to higher levels of child behavior problems. Child IQ was the only significant predictor of observer ratings of child regulation at 6 months postinjury, with higher IQ scores associated with better child self-regulation. The corresponding effect size was moderate in magnitude. CBCL ADHD scores at 6 months were not associated with caregiver distress, family functioning, or child intelligence.

The Relationship of Parent Warm Responsiveness to Emerging Behavior Problems

Prospective analyses testing the moderation hypothesis—There was no evidence for moderation in the models examining the CBCL externalizing, internalizing, and ADHD totals at 6 months postinjury or for observer ratings of child regulation, after controlling for race, SES, IQ, family functioning, and caregiver distress.

Cross-sectional models examining the moderation hypothesis—In the model for the externalizing behavior total, we found a significant interaction between severe TBI versus OI and parental warm responsiveness, $t(1, 169) = -2.87$, $p = .005$. As depicted in Figure 1, children with severe TBI and parents with high levels of warm responsiveness had fewer behavior problems at 6 months postinjury than did those with less responsive parents; whereas parental warm responsiveness was unrelated to behavior problems in the moderate TBI and OI groups. Estimates of group differences between the severe TBI and OI at high ($M = 18.5$, $SE = 2.22$) and low ($M = 31.0$, $SE = 4.6$) levels of parental warm responsiveness reveal significant group differences at both levels with less marked differences at high levels of warm responsiveness.

Similarly, greater parental warm responsiveness at 6 months was associated with lower levels of internalizing and ADHD symptoms in the severe TBI group but not the moderate or OI groups, $t(1, 172) = -2.31$, $p = .02$ (see Table 5). Differences in internalizing symptoms between the severe TBI and OI groups were significant among those with high ($M = 12.0$, $SE = 4.07$) and low ($M = 21.9$, $SE = 8.01$) levels of parental warm responsiveness, with high levels of warm responsiveness corresponding to less pronounced group differences in internalizing symptoms at 6 months. The estimates of differences in ADHD symptoms between the severe TBI and OI groups reveals a similar pattern of findings, with less marked differences at high levels of responsiveness ($M = 12.1$, $SE = 3.10$) than at low levels ($M = 21.5$, $SE = 6.11$), $t(1,170) = -2.90$; $p = .004$.

The Relationship of Parent Negativity to Emerging Behavior Problems

Prospective analyses—Caregiver negativity at Visit 1 moderated the association of severe TBI to externalizing behavior problems, accounting for 8% of the variance, $t(1, 170) = -3.86$, $p = .0002$ (see Table 5). As depicted in Figure 2, parental negativity was associated with higher levels of externalizing behaviors following severe TBI. The estimates of the difference in externalizing symptoms between the severe TBI and OI groups were not significant for those with no parental negativity ($M = 3.7$, $SE = 2.08$), whereas they were highly significant in those with any parental negativity ($M = 33.0$, $SE = 7.20$).

Caregiver negativity at baseline did not moderate the association between severe TBI and internalizing behaviors at 6 months postinjury, nor did it account for significant variance in the sample as a whole (see Table 5). With respect to ADHD scores, the interaction of severe TBI and parental negativity was significant, $t(1,170) = -3.43$, $p = .0007$. Consistent with hypotheses, any caregiver negativity at baseline was associated with higher levels of emerging ADHD symptoms in the context of severe TBI. As with externalizing symptoms, the severe TBI and OI groups differed on ADHD symptoms when parents displayed negativity ($M = 21.5$, $SE = 5.4$) but not in the absence of parental negativity ($M = 0.96$, $SE = 1.54$).

Cross-sectional models of caregiver negativity and child behavior—Caregiver negativity at Time 2 also moderated the association of severe TBI to externalizing behavior problems at 6 months postinjury. Consistent with the prospective models, caregiver negativity exacerbated the effects of severe TBI on externalizing symptoms, $t(1, 169) = -2.40$, $p = .02$. Severe and OI groups differed in both the absence ($M = 4.6$, $SE = 2.18$) and

presence of parental negativity (M = 23. 6, SE = 7.00), with greater group differences in the presence of parental negativity. Caregiver negativity at 6 months postinjury also moderated the effects of TBI on internalizing symptoms following moderate TBI, $t(1, 168) = 2.31$, $p = .02$. Examination of this interaction revealed that the moderate TBI group differed from the OI group in the presence (M = −10.9, SE = 5.6) as well as the absence of negativity (M = 3.2, SE = 1.3), with the moderate TBI group reporting higher levels of internalizing symptoms than the OI group in the presence of parental negativity. However, in the absence of parental negativity, children with OI were rated as having higher levels of internalizing symptoms than children with moderate TBI. As the only interaction involving children with moderate TBI, this finding should be interpreted with caution. Caregiver negativity was unrelated to CBCL ADHD scores or ratings of behavioral regulation in these cross-sectional analyses.

Discussion

The current findings provide preliminary evidence regarding the importance of both parental warm responsiveness and negativity to changes in behavior following early childhood TBI. Consistent with previous research, parental warm responsiveness was associated with lower levels of internalizing and externalizing behavior problems as well as ADHD symptoms, particularly in the context of severe TBI. In contrast, parental negativity was associated with more externalizing behavior problems and ADHD symptoms following severe TBI, whereas negativity was associated with higher levels of internalizing behaviors following moderate TBI. Because the models statistically controlled for preinjury levels of behavior problems, these findings provide evidence regarding the relationship of parenting behaviors to the emergence of new behavior problems following TBI. Moreover, these relationships held true even after accounting for the effects of race, SES, parental distress, and family functioning on child behavior. These findings suggest that the effects of responsiveness and negativity on emerging behavior problems extend beyond sociocultural differences in parenting style and are not merely artifacts of group differences in caregiver depression or family dysfunction. Taken together, these findings have implications for family-centered interventions during the initial months following TBI in young children.

As hypothesized, parental behaviors were more strongly related to externalizing behaviors than internalizing behaviors in both prospective and cross-sectional analyses. In addition, TBI itself had less pronounced effects on emerging internalizing problems. Although anxiety and depressive symptoms have been noted in cohorts of older, school-age children with TBI (e.g., Vasa et al., 2002), it is possible that they are less common or less readily identified following early childhood TBI. Conversely, it is possible that orthopedic injuries are also associated with emerging internalizing symptoms thereby obscuring changes following TBI.

The Importance of Parental Responsiveness

Warm responsiveness was negatively associated with emerging externalizing, internalizing, and ADHD symptoms following severe TBI in cross-sectional, but not prospective, analyses. The importance of warm responsiveness for reducing emerging behavior problems following early TBI is consistent with considerable previous literature documenting the relationship of positive parenting qualities, such as warmth, approval, responsiveness, and synchrony, to greater effortful control, more favorable child adjustment, and fewer externalizing problems (Bradley & Corwyn, 2007; Davidov & Grusec, 2006; Eisenberg et al., 2005; Rothbaum & Weisz, 1994; Shaw et al., 1998). There is also some evidence that parental warmth may mitigate the adverse effects of harsh discipline on externalizing behaviors (Deater-Deckard et al., 2006). Children's behavior is frequently dysregulated during the acute phase of recovery from TBI, and this lack of control can be alarming for

both parent and child. Parental warm responsiveness may provide consistent, positive feedback from the environment that, in turn, facilitates self-regulation over time. Evidence suggests that parental responsiveness may prevent the emergence of conduct problems in children with ADHD (Chronis et al., 2007). The current findings provide tentative evidence that warm responsiveness may be associated with lower levels of all types of symptoms following severe TBI.

The Role of Negativity

Our finding of a significant relationship between parental negativity and emerging externalizing behaviors is consistent with previous studies in typically developing and economically disadvantaged children which demonstrated a relationship between parental harshness and negativity and externalizing behaviors over time (Ackerman et al., 2003; Dodge, Pettit, & Bates, 1994; Rubin et al., 2003). Parental negativity shortly after the injury had a strong influence on externalizing behaviors following severe TBI. Consistent with Patterson's (1982) model of reciprocal influences, some parents may respond to the child's acute dysregulation and emotional lability following severe TBI with criticism and harsh discipline. In those cases, the child may exhibit further dysregulation, resulting in a cycle of mounting parental negativity and escalating child behavior problems. It is worth noting that displays of parental negativity were uncommon during these videotaped interactions, with the majority of parents displaying no negativity at all. Thus, it is difficult to determine whether even low levels of parental negativity are sufficient to result in externalizing problems following severe TBI, or whether observed negative parenting behaviors were the “tip of the iceberg” and reflective of more marked parental harshness.

Lack of Association Between Parenting Behaviors and Child Regulation

Contrary to expectations, neither parental responsiveness nor negativity was related to child behavioral regulation during the free play observation. By 6 months after injury, any level of dysregulation during the free play session was fairly uncommon, with only 16% of the sample being classified as exhibiting any dysregulation and no differences among the groups. Thus, the child's behavior during 10 min of unstructured playtime may bear little relationship to the child's behavior in settings or situations in which there are greater demands placed upon the child. It is interesting that the child's IQ was the only predictor of behavioral regulation suggesting that children with cognitive deficits may have more difficulty maintaining self-regulation, even in an undemanding situation.

Prospective Versus Cross-Sectional Relationships

Parental negativity was more closely related to emerging externalizing and ADHD symptoms in prospective than in cross sectional analyses. Although these findings could reflect the cumulative influences of child behavior problems on parenting, they are also consistent with effects of early postinjury parenting characteristics on subsequent child behavior. It is worth noting that this pattern of stronger prospective influences was found only for parental negativity and not warm responsive parenting, suggesting that the effects of parental harshness shortly after injury may be more potent than those of parental warmth. Although not statistically significant, the trend indicated parental warm responsiveness declined between the baseline and 6-month assessments for both the severe TBI and OI groups but not the moderate TBI group, and this may account for the lack of prospective associations. Thus, the quality of concurrent parental responsiveness may be a more potent predictor of emerging behavior problems than prior responsiveness, particularly if the parent has become less responsive over time since the injury.

Implications for Intervention

The current findings suggest that it may be possible to ameliorate or prevent some of the deterioration in behavior following early TBI by training parents to avoid negativity and practice positive parenting skills, such as warmth and contingent responsiveness. Evidence suggests that responsive parenting, even if not consistent over development, is associated with better social and developmental outcomes than no exposure to positive parenting (Landry et al., 2001), with greater effects among children at biological risk. Moreover, parenting skills programs (Triple P, Parent Child Interaction Therapy) that foster parental warmth and responsiveness have been shown to reduce behavior problems (Eyberg, 1988; Nowak & Henrichs, 2008). Taken together, these results point to the potential utility of early parenting skills programs to reduce the acute behavioral morbidity associated with severe TBI. It is interesting that, in the current study, involvement in therapies including counseling following injury was unrelated to emerging behavior problems. However, the proportion of children receiving therapies of any type was fairly low and did not differ by injury severity or group. Moreover, the design of the current study provided little detail about the nature of these therapies. However, it is likely that they focused on the child's speech, behavior, and functioning, rather than on parenting skills.

Limitations

The current findings must be considered in the context of the limitations of this investigation. Child behaviors were based on parent report and are thus confounded to some extent with parental behaviors and perceptions potentially inflating the association between parenting behaviors and child behavior problems. For example, parents with high levels of burden or distress may behave less responsively and may rate the child as having more problems. To address this issue, parental distress and family functioning were included as covariates in the analyses. Although these factors explained significant variance in internalizing and externalizing symptoms on the CBCL, the moderation effects remained significant. Moreover, neither parental distress nor family functioning was related to the CBCL ADHD scale, after controlling for baseline/preinjury scores. These findings suggest that the current findings cannot be attributed to this potential confound.

Although efforts were made to conceal the nature of the child's injury from the observer's conducting the ratings, this was not always possible because of visible casts on the children with orthopedic injuries at the initial assessments. Thus, there remains the possibility that observer ratings of parental warmth and negativity may have been influenced by an awareness of group status.

Preinjury estimates of child behavior were based on retrospective ratings made after the injury and thus may be biased by subsequent changes in behavior. Obtaining retrospective reports of premorbid functioning is a common practice in brain injury research, as it is virtually impossible, outside of epidemiological studies, to have measures of behavior that were truly collected prior to the injury. The failure to find differences among the groups at baseline suggests that the groups were not biased in their recall, but this nonetheless remains a significant limitation of this and most pediatric TBI studies. Another limitation is that postacute child behavior problems were not assessed at baseline, and thus, we could not examine the extent to which earlier postinjury behavioral changes may have lead to changes in parenting, as opposed to parenting styles contributing to child behavioral change. Future research that measures more immediate child behavioral change and that incorporates structured clinical interviews of child functioning or psychiatric status may serve to provide additional, externally valid perceptions of child functioning.

Being aware of being observed may cause changes in the behavior of the person being observed. Because ratings of parental behavior were made based on relatively brief structured interactions in the laboratory, they may not fully capture the range of the parent's behavior in the home setting. In particular, parents may have been less likely to engage in negative or harsh behaviors toward the child, resulting in a restricted range of negativity. Longer observations in more naturalistic environments (i.e., home) may serve to address these concerns.

Conclusions

The current findings provide preliminary evidence that positive parenting behaviors, such as warm responsiveness and an absence of negativity, may reduce the adverse effects of severe TBI on child behavior. The results have potentially important clinical implications, as several efficacious parenting skills programs exist that target positive parenting characteristics, such as praise and following the child's lead. Given the dearth of interventions to improve behavioral outcomes following TBI, parenting skills programs could be adapted and implemented with this population to reduce behavioral morbidity. Further research is needed to examine the reciprocity between parent and child behaviors and whether acute changes in child behaviors contribute to decrements in parental responsiveness. This study focused on the initial 6 months following injury, and thus, further longitudinal investigation will be necessary to determine whether parental warm responsiveness and negativity remain important determinants of child behavior over time. Taken together, these findings provide additional evidence regarding the importance of the social environment following childhood TBI (Taylor et al., 2002; Yeates et al., 2004) and point toward potential avenues for intervention.

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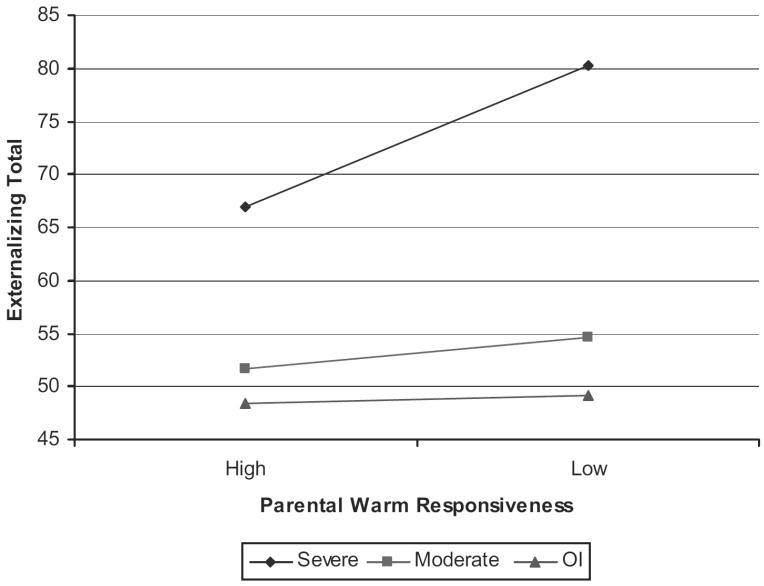

Figure 1.

The interaction of parental warm responsiveness at the six month follow-up with group in predicting levels of externalizing symptoms at 6 months postinjury. Children with severe traumatic brain injury (TBI) and parents with high levels of warm responsiveness had fewer externalizing symptoms at 6 months postinjury than did those with less responsive parents, whereas parental warm responsiveness was unrelated to behavior problems in the moderate TBI and orthopedic injury (OI) groups. Children with severe TBI had significantly higher levels of externalizing symptoms than did children with OI at both high and low levels of parent responsiveness, with less marked differences at high levels of warm responsiveness.

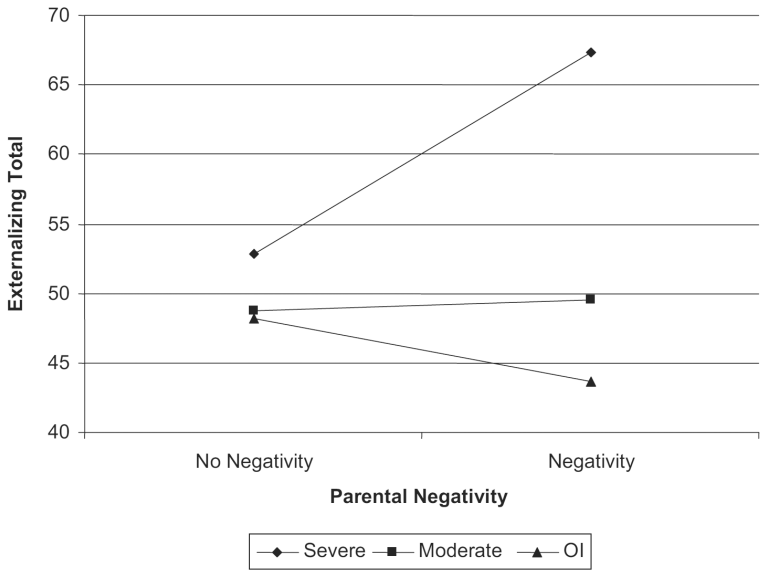

Figure 2.

The interaction of parental negativity at Visit 1 with group in predicting levels of externalizing symptoms at 6 months postinjury. Parental negativity during the initial months post injury was associated with higher levels of externalizing behaviors at the 6-month follow-up following severe traumatic brain injury (TBI). The estimates of the difference in externalizing symptoms between the severe TBI and orthopedic injury (OI) groups were not significant for those with no parental negativity ($M = 3.7$, $SE = 2.08$), whereas they were highly significant in those with any parental negativity ($M = 33.0$, $SE = 7.20$).

Table 1

Demographic and Baseline Characteristics in Completers (n = 179) and Noncompleters (n = 35)

Characteristic	Dropout	Completer	Statistics
Race			$\chi^2(1) = 1.36$, $p = .24$
White	22 (14%)	130 (86%)	
Non-White	13 (21%)	49 (79%)	
Sex			$\chi^2(1) = 0.81$, $p = .37$
Male	23 (18%)	103 (82%)	
Female	12 (14%)	76 (86%)	
Marital status			$\chi^2(1) = 0.63$, $p = .43$
Married	25 (15%)	139 (85%)	
Unmarried	10 (20%)	40 (80%)	
M composite income/education *(SD)*	−0.15 (−0.49)	0.04 (−0.11)	$t(212) = -1.03$, $p = .30$
M child's age in years *(SD)*	5.07 (1.04)	5.02 (1.12)	$t(212) = -0.25$, $p = .80$
M child's regulation *(SD)*	4.59 (0.92)	4.75 (0.60)	$t(203) = -1.30$, $p = .19$
M CBCL Externalizing *(SD)*	49.94 (14.03)	48.47 (12.52)	$t(204) = 0.59$, $p = .56$
M CBCL Internalizing *(SD)*	47.10 (12.06)	48.30 (11.40)	$t(204) = -0.52$, $p = .61$
M CBCL ADHD *(SD)*	54.71 (8.27)	53.84 (6.58)	$t(204) = 0.56$, $p = .58$
M parental negativity *(SD)*	0.68 (0.47)	0.74 (0.44)	$t(202) = -0.77$, $p = .44$
M parental warm responsive *(SD)*	2.86 (0.77)	3.12 (0.94)	$t(202) = -1.52$, $p = .13$
M time since injury *(SD)*	0.12 (0.05)	0.11 (0.06)	$t(212) = 0.74$, $p = .46$
M IQ *(SD)*	95.54 (16.63)	99.19 (15.85)	$t(209) = 1.23$, $p = .22$
M FAD *(SD)*	−0.15 (0.70)	0.00 (1.04)	$t(186) = -0.54$, $p = .59$
M BSI-GSI *(SD)*	50.12 (9.68)	51.16 (11.24)	$t(206) = -0.49$, $p = .62$

Note. CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001); ADHD = Attention-Deficit/Hyperactivity Disorder Scale of the CBCL; IQ = intelligence quotient; FAD = Family Assessment Device (Miller, Bishop, Epstein, & Keitner, 1985); BSI-GSI = Brief Symptom Inventory General Severity Index (Derogatis & Spencer, 1985).

Table 2

Participant Characteristics by Group

Characteristic	Severe TBI (*n* = 19)	Moderate TBI (*n* = 51)	OI (*n* = 109)	Difference $p < .05$*
Age at injury (years)	5.18 (0.99)	44.87 (1.23)	5.04 (1.10)	*ns*
GCS score	3.73 (1.56)	13.53 (1.98)		Sev < Mod
Days in hospital	8.72 (20.82)	2.18 (1.98)	0.79 (0.51)	Sev > Mod; Sev > OI
ISS	12.06 (8.52)	15.08 (7.45)	7.08 (2.28)	Sev > OI; Mod > OI
IQ at baseline	86.38 (15.82)	98.65 (16.81)	101.75 (14.63)	Sev < Mod; Sev < OI
Boys: *n* (%)	13 (68.4%)	33 (64.7%)	57 (52.3%)	*ns*
Race: *n* (%)				*ns*
White	13 (68.4%)	35 (68.5%)	82 (75.2%)	
African American	5 (26.3%)	10 (19.6%)	20 (18.3%)	
Mixed/other	1 (5.3%)	8 (11.8%)	7 (6.4%)	
Maternal education	*ns*			
≤High school: *n* (%)	6 (31.5%)	7 (13.7%)	7 (6.4%)	
Income	$49,9995 ($12,041)	$60,758 ($23,283)	$62,864 ($24,598)	Sev < OI

Note. TBI = traumatic brain injury; Sev = severe TBI; Mod = moderate TBI; OI = orthopedic injury; GCS = Glasgow Coma Scale score (Teasdale & Jennett, 1974); ISS = injury severity score; IQ = intelligence quotient. Values are presented as *M (SD)* unless otherwise specified. Income was based on the median income for the individual's census tract based on the most recent available census data.

* Significant at the 0.05 level.

Table 3

Time Varying Outcome Variables and Predictors

	Severe (*n* = 19)				Moderate (*n* = 51)				OI (*N* = 109)						
	Visit 1		Visit 2		Visit 1		Visit 2		Visit 1		Visit 2		Significant differences*		
Variable	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	**Group**	**Time**	**Group × Time**
Outcome variables															
Externalizing	51.97	13.83	59.05	12.67	48.54	11.69	49.12	13.13	47.71	12.60	46.94	11.56	Sev > OI	T1 < T2	Sev T1 < Sev T2; Sev T2 > Mod T2; Sev T2 > OI T2
Internalizing	51.25	13.66	53.63	14.20	48.56	10.31	49.29	10.73	47.94	11.51	46.58	11.08	*ns*	*ns*	*ns*
ADHD	54.38	6.24	58.37	7.68	53.72	5.65	54.31	7.46	53.72	6.72	53.53	6.42	*ns*	T1 < T2	Sev T1 < Sev T2; Sev T2 > OI T2
Behavior regulation	4.41	0.92	4.61	1.05	4.53	0.81	4.86	0.35	4.91	0.30	4.88	0.31	Sev < OI, Sev < Mod	T1 > T2	Sev T1 < OI T1; Mod T1 < Mod T2; Mod T1 < OI T1
Predictor variables															
Warm responsive	3.23	0.88	2.75	0.82	2.80	0.99	2.81	1.03	3.26	0.87	3.04	0.96	Mod < OI	T1 > T2	*ns*
Negativity (%)	26.30		31.60		33.30		19.60		26.60		19.30		*ns*	*ns*	*ns*

Note. TBI = traumatic brain injury; Sev = severe TBI; Mod = moderate TBI; OI = orthopedic injury; T1 = baseline; T2 = 6-month follow-up; Externalizing = the Externalizing Problems *T* score from the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001); Internalizing = the Internalizing Problems *T* score from the CBCL; ADHD = the Attention-Deficit/Hyperactivity Disorder *T* score from the CBCL; % negativity = the proportion of parents displaying at least some negativity.

*Significant at the 0.05 level.

Table 4

Time Varying Variables Dichotomized: Percentage Above or Below Clinical Cutoff (n = 179)

	Baseline			6 months		
Variable	**Severe**	**Moderate**	**OI**	**Severe**	**Moderate**	**OI**
CBCL: Externalizing Problems *T* score[a]						
Above cutoff	22.22	10.20	9.26	47.37	11.76	10.09***
Below cutoff	77.78	89.80	90.74	52.63	88.24	89.91
CBCL: Internalizing Problems *T* score[a]						
Above cutoff	27.78	8.16	5.56**	31.58	11.76	7.34**
Below cutoff	72.22	91.84	94.44	68.42	88.24	92.66
CBCL: Attention Deficit Problems *T* score*						
Above cutoff	16.67	8.16	11.11	31.58	13.73	10.09*
Below cutoff	83.33	91.84	88.89	68.42	86.27	89.91
Average child behavior regulation						
4 or below	33.33	23.68	4.21**	11.76	10.87	6.52
A score of 5	66.67	76.32	95.79	88.24	89.13	93.48

Note. CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001); OI = orthopedic injury.

[a]Clinical cutoff at 63.

*$p < .05$.

**$p < .001$.

***$p < .0001$.

Table 5

Hierarchical Analyses of the Relationship of Caregiver Warm Responsiveness and Negativity to Externalizing and Internalizing Behavior Problems, ADHD Symptoms, and Behavior Regulation

Variable	*B*	*SE B*	β
Prospective models for warm responsiveness			
Externalizing at Visit 2 with warm responsiveness at Visit 1 as moderator (n = 179)			
Untrimmed main effects model			
Externalizing CBCL Visit 1	0.73	0.05	0.72***
Composite income/education	−0.12	0.70	−0.01
Child's race	−1.43	1.37	−0.05
Severe TBI group	7.74	1.98	0.19***
Moderate TBI group	0.94	1.29	0.03
Time since injury	−6.50	10.37	−0.03
GCA IQ	−0.02	0.04	−0.03
FAD	−0.92	0.60	−0.08
BSI-GSI	0.16	0.06	0.14***
Warm responsiveness Visit 1	−0.82	0.68	−0.06
Moderation model with nonsignificant covariates trimmed			
Externalizing Visit 1	0.71	0.05	0.70***
Composite income/education	−0.45	0.66	−0.04
Child's race	−1.38	1.35	−0.05
Severe TBI group	12.48	7.14	0.31
Moderate TBI group	5.39	4.11	0.19
BSI-GSI	0.12	0.05	0.11**
Warm responsiveness Visit 1	−0.19	0.85	−0.01
Severe TBI × Warm Responsiveness	−1.50	2.14	−0.12
Moderate TBI × Warm Responsiveness	−1.51	1.31	−0.16
Internalizing at Visit 2 with warm responsiveness at Visit 1 as moderator (n = 179)			
Untrimmed main effects model			
Internalizing Visit 1	0.72	0.05	0.72***
Composite income/education	0.02	0.69	0.00
Child's race	−1.95	1.35	−0.08
Severe TBI group	3.12	1.95	0.08
Moderate TBI group	1.56	1.28	0.06
Time since injury	−0.15	10.26	0.00
GCA IQ	−0.04	0.04	−0.06
FAD	−1.25	0.59	−0.12*
BSI-GSI	0.16	0.06	0.16**
Warm responsiveness Visit 1	−0.43	0.67	−0.03
Moderation model with nonsignificant covariates trimmed			

Variable	*B*	*SE B*	β
Internalizing Visit 1	0.72	0.05	0.71***
Composite income/education	−0.31	0.65	−0.03
Child's race	−2.10	1.33	−0.08
Severe TBI group	10.03	7.02	0.27
Moderate TBI group	1.42	4.07	0.06
FAD	−1.31	0.59	−0.12*
BSI-GSI	0.16	0.06	0.16**
Warm responsiveness Visit 1	−0.34	0.84	−0.03
Severe TBI × Warm Responsiveness	−2.03	2.10	−0.18
Moderate TBI × Warm Responsiveness	0.09	1.30	0.01
ADHD at Visit 2 with warm responsiveness at Visit 1 as moderator (*n* = 179)			
Untrimmed main effects model			
ADHD Visit 1	0.63	0.07	0.57***
Composite income/education	−0.90	0.52	−0.13
Child's race	−0.83	1.02	−0.05
Severe TBI group	4.34	1.47	0.19**
Moderate TBI group	0.49	0.96	0.03
Time since injury	−1.47	7.70	−0.01
GCA IQ	0.05	0.03	0.11
FAD	0.13	0.45	0.02
BSI-GSI	0.00	0.04	0.00
Warm responsiveness Visit 1	−0.65	0.51	−0.09
Moderation model with nonsignificant covariates trimmed			
ADHD Visit 1	0.63	0.07	0.57***
Composite income/education	−0.64	0.47	−0.09
Child's race	−0.72	0.99	−0.05
Severe TBI group	12.61	5.19	0.56*
Moderate TBI group	5.82	3.02	0.38
Warm responsiveness Visit 1	0.37	0.63	0.05
Severe TBI × Warm Responsiveness	−2.70	1.56	−0.40
Moderate TBI × Warm Responsiveness	−1.79	0.97	−0.35
Behavioral regulation with warm responsiveness at Visit 1 as moderator (*n* = 170)			
Untrimmed main effects model			
Composite income/education	−0.06	0.04	−0.15
Child's race	−0.04	0.07	−0.05
Severe TBI group	−0.01	0.10	−0.01
Moderate TBI group	0.03	0.07	0.04
Time since injury	−0.14	0.53	−0.02
GCA IQ	0.01	0.00	0.28**
FAD	0.02	0.03	0.05

Variable	*B*	*SE B*	β
BSI-GSI	0.00	0.00	0.06
Warm responsiveness Visit 1	0.02	0.04	0.06
Moderation model with nonsignificant covariates trimmed			
Composite income/education	−0.05	0.04	−0.15
Child's race	−0.05	0.07	−0.06
Severe TBI group	−0.45	0.36	−0.38
Moderate TBI group	0.11	0.22	0.14
GCA IQ	0.01	0.00	0.29**
Warm responsiveness Visit 1	0.01	0.04	0.04
Severe TBI × Warm Responsiveness	0.14	0.11	0.40
Moderate TBI × Warm Responsiveness	−0.03	0.07	−0.11
Cross-sectional models			
Externalizing total at Visit 2 with warm responsiveness at Visit 2 as moderator (n = 179)			
Untrimmed main effects model			
Externalizing Visit 1	0.73	0.05	0.72***
Composite income/education	−0.05	0.69	0.00
Child's race	−1.23	1.35	−0.04
Severe TBI group	7.48	1.95	0.18***
Moderate TBI group	0.96	1.27	0.03
Time since injury	−3.05	10.29	−0.01
GCA IQ	−0.02	0.04	−0.02
FAD	−1.03	0.60	−0.09
BSI-GSI	0.16	0.06	0.14**
Warm responsiveness Visit 2	−1.31	0.63	−0.10*
Moderation model with nonsignificant covariates trimmed			
Externalizing Visit 1	0.72	0.05	0.71***
Composite income/education	−0.48	0.63	−0.04
Child's race	−1.40	1.32	−0.05
Severe TBI group	24.77	6.31	0.61***
Moderate TBI group	4.41	3.70	0.16
BSI-GSI	0.11	0.05	0.10*
Warm responsiveness Visit 2	−0.37	0.77	−0.03
Severe TBI × Warm Responsiveness	−6.25	2.18	−0.44**
Moderate TBI × Warm Responsiveness	−1.16	1.21	−0.13
Internalizing total at Visit 2 with warm responsiveness at Visit 2 as moderator (n = 179)			
Untrimmed main effects model			
Internalizing Visit 1	0.72	0.05	0.71***
Composite income/education	0.13	0.68	0.01
Child's race	−1.62	1.33	−0.06

Variable	*B*	*SE B*	β
Severe TBI group	2.99	1.91	0.08
Moderate TBI group	1.48	1.25	0.06
Time since injury	2.54	10.18	0.01
GCA IQ	−0.03	0.04	−0.05
FAD	−1.34	0.59	−0.13*
BSI-GSI	0.16	0.06	0.16**
Warm responsiveness Visit 2	−1.17	0.62	−0.10
Moderation model with nonsignificant covariates trimmed			
Internalizing Visit 1	0.72	0.05	0.72***
Composite income/education	−0.21	0.62	−0.02
Child's race	−1.90	1.30	−0.07
Severe TBI group	16.95	6.20	0.46**
Moderate TBI group	−0.82	3.65	−0.03
FAD	−1.38	0.57	−0.13*
BSI-GSI	0.16	0.06	0.16**
Warm responsiveness Visit 2	−1.07	0.75	−0.09
Severe TBI × Warm Responsiveness	−4.95	2.14	−0.38*
Moderate TBI × Warm Responsiveness	0.86	1.19	0.10
ADHD total at Visit 2 with warm responsiveness at Visit 2 as moderator (n = 179)			
Untrimmed main effects model			
ADHD Visit 1	0.63	0.07	0.57***
Composite income/education	−0.92	0.52	−0.13
Child's race	−0.87	1.01	−0.06
Severe TBI group	4.13	1.47	0.18**
Moderate TBI group	0.60	0.95	0.04
Time since injury	0.47	7.71	0.00
GCA IQ	0.05	0.03	0.11
FAD	0.08	0.45	0.01
BSI-GSI	0.00	0.04	0.00
Warm responsiveness Visit 2	−0.58	0.48	−0.08
Moderation model with nonsignificant covariates trimmed			
ADHD Visit 1	0.63	0.06	0.58***
Composite income/education	−0.70	0.46	−0.10
Child's race	−0.92	0.98	−0.06
Severe TBI group	16.78	4.69	0.74**
Moderate TBI group	3.23	2.76	0.21
Warm responsiveness Visit 2	0.21	0.57	0.03
Severe TBI × Warm Responsiveness	−4.70	1.62	−0.60**
Moderate TBI × Warm Responsiveness	−0.91	0.90	−0.18

Variable	*B*	*SE B*	β
Behavioral regulation with warm responsiveness at Visit 2 as moderator (*n* = 179)			
Untrimmed main effects model			
Composite income/education	−0.06	0.04	−0.16
Child's race	−0.05	0.07	−0.06
Severe TBI group	0.00	0.10	0.00
Moderate TBI group	0.04	0.07	0.05
Time since injury	−0.27	0.53	−0.04
GCA IQ	0.01	0.00	0.27**
FAD	0.02	0.03	0.06
BSI-GSI	0.00	0.00	0.06
Warm responsiveness Visit 2	0.05	0.03	0.13
Moderation model with nonsignificant covariates trimmed			
Composite income/education	−0.06	0.03	−0.17
Child's race	−0.06	0.07	−0.07
Severe TBI group	−0.31	0.32	−0.26
Moderate TBI group	0.04	0.20	0.04
GCA IQ	0.01	0.00	0.28**
Warm responsiveness Visit 2	0.04	0.04	0.09
Severe TBI × Warm Responsiveness	0.11	0.11	0.28
Moderate TBI × Warm Responsiveness	0.00	0.07	−0.01
Prospective models for negativity			
Externalizing total at Visit 2 with negativity at Visit 2 as moderator (*n* = 179)			
Untrimmed main effects model			
Externalizing Visit 1	0.73	0.05	0.72***
Composite income/education	−0.23	0.70	−0.02
Child's race	−1.79	1.34	−0.06
Severe TBI group	7.52	1.97	0.18***
Moderate TBI group	1.17	1.28	0.04
Time since injury	−5.31	10.36	−0.02
GCA IQ	−0.03	0.04	−0.04
FAD	−0.97	0.61	−0.08
BSI-GSI	0.16	0.06	0.14***
Negativity Visit 1	−0.70	1.26	−0.03
Moderation model with nonsignificant covariates trimmed			
Externalizing Visit 1	0.74	0.05	0.73***
Composite income/education	−0.59	0.62	−0.05
Child's race	−2.62	1.29	−0.09
Severe TBI group	18.33	3.56	0.45***
Moderate TBI group	3.81	2.23	0.14
BSI-GSI	0.10	0.05	0.09

Variable	*B*	*SE B*	β
Negativity Visit 1	2.39	1.58	0.09
Severe TBI × Negativity	−14.68	4.13	−0.31**
Moderate TBI × Negativity	−3.72	2.69	−0.12
Internalizing total at Visit 2 with negativity at Visit 1 as moderator (*n* = 179)			
Untrimmed main effects model			
Internalizing Visit 1	0.72	0.05	0.72***
Composite income/education	−0.08	0.69	−0.01
Child's race	−2.15	1.31	−0.08
Severe TBI group	2.94	1.94	0.08
Moderate TBI group	1.72	1.26	0.07
Time Since injury	0.51	10.22	0.00
GCA IQ	−0.05	0.04	−0.06
FAD	−1.22	0.60	−0.11***
BSI-GSI	0.16	0.06	0.16***
Negativity Visit 1	0.22	1.24	0.01
Moderation model with nonsignificant covariates trimmed			
Internalizing Visit 1	0.72	0.05	0.72***
Composite income/education	−0.43	0.64	−0.04
Child's race	−2.41	1.32	−0.09
Severe TBI group	4.42	3.59	0.12
Moderate TBI group	1.05	2.26	0.04
FAD	−1.31	0.60	−0.12*
BSI-GSI	0.17	0.06	0.17**
Negativity Visit 1	0.02	1.62	0.00
Severe TBI × Negativity	−1.48	4.16	−0.03
Moderate TBI × Negativity	1.10	2.73	0.04
ADHD total at Visit 2 with negativity at Visit 1 as moderator (*n* = 179)			
Untrimmed main effects model			
ADHD Visit 1			0.63
Composite income/education	−0.99	0.51	−0.14
Child's race	−1.12	0.99	−0.07
Severe TBI group	4.16	1.47	0.18***
Moderate TBI group	0.70	0.95	0.05
Time since injury	−0.54	7.70	0.00
GCA IQ	0.04	0.03	0.09
FAD	0.10	0.45	0.01
BSI-GSI	0.00	0.04	0.00
Negativity Visit 1	−0.36	0.95	−0.02
Moderation model with nonsignificant covariates trimmed			

Variable	*B*	*SE B*	β
ADHD Visit 1	0.65	0.07	0.59***
Composite income/education	−0.81	0.45	−0.12
Child's race	−1.47	0.95	−0.09
Severe TBI group	11.17	2.60	0.49***
Moderate TBI group	−0.17	1.63	−0.01
Negativity Visit 1	0.41	1.18	0.03
Severe TBI × Negativity	−10.18	3.04	−0.39***
Moderate TBI × Negativity	1.16	1.97	0.07
Behavioral responsiveness with negativity at Visit 1 as moderator (n = 170)			
Untrimmed main effects model			
Composite income/education	−0.05	0.04	−0.14
Child's race	−0.03	0.07	−0.04
Severe TBI group	0.00	0.10	0.00
Moderate TBI group	0.03	0.07	0.03
Time since injury	−0.17	0.53	−0.03
GCA IQ	0.01	0.00	0.29***
FAD	0.02	0.03	0.05
BSI-GSI	0.00	0.00	0.06
Negativity Visit 1	0.01	0.06	0.02
Moderation model with nonsignificant covariates trimmed			
Composite income/education	−0.05	0.03	−0.13
Child's race	−0.06	0.07	−0.07
Severe TBI group	0.25	0.18	0.21
Moderate TBI group	0.21	0.11	0.25
GCA IQ	0.01	0.00	0.29**
Negativity Visit 1	0.11	0.08	0.14
Severe TBI × Negativity	−0.32	0.21	−0.24
Moderate TBI × Negativity	−0.26	0.14	−0.28
Cross-sectional models for negativity			
Externalizing total at Visit 2 with negativity at Visit 2 as moderator (n = 179)			
Externalizing Visit 1	0.73	0.05	0.73***
Composite income/education	−0.25	0.70	−0.02
Child's race	−1.76	1.35	−0.06
Severe TBI group	7.41	1.97	0.18***
Moderate TBI group	1.22	1.28	0.04
Time since injury	−5.64	10.43	−0.02
GCA IQ	−0.03	0.04	−0.04
FAD	−0.94	0.61	−0.08
BSI-GSI	0.16	0.06	0.14**
Negativity Visit 2	−0.43	1.41	−0.01

Variable	*B*	*SE B*	β
Moderation model with nonsignificant covariates trimmed			
Externalizing Visit 1	0.73	0.05	0.72***
Composite income/education	−0.81	0.64	−0.06
Child's race	−2.20	1.32	−0.08
Severe TBI group	14.13	3.44	0.35***
Moderate TBI group	3.25	2.85	0.12
BSI-GSI	0.11	0.05	0.10*
Negativity Visit 2	2.27	1.84	0.07
Severe TBI × Negativity	−9.51	4.08	−0.20*
Moderate TBI × Negativity	−2.59	3.22	−0.09
Internalizing total at Visit 2 with negativity at Visit 2 as moderator (n = 179)			
Untrimmed main effects model			
Internalizing Visit 1	0.72	0.05	0.72***
Composite income/education	0.01	0.68	0.00
Child's race	−1.97	1.32	−0.08
Severe TBI group	2.84	1.93	0.08
Moderate TBI group	1.73	1.25	0.07
Time since injury	−0.64	10.26	0.00
GCA IQ	−0.05	0.04	−0.07
FAD	−1.34	0.59	−0.12*
BSI-GSI	0.16	0.06	0.16**
Negativity Visit 2	−1.39	1.38	−0.05
Moderation model with nonsignificant covariates trimmed			
Internalizing Visit 1	0.73	0.05	0.72***
Composite income/education	0.09	0.64	0.01
Child's race	−2.10	1.29	−0.08
Severe TBI group	−0.97	3.34	−0.03
Moderate TBI group	−3.87	2.80	−0.15
FAD	−1.56	0.59	−0.15**
BSI-GSI	0.18	0.06	0.18**
Negativity Visit 2	−4.26	1.82	−0.15*
Severe TBI × Negativity	6.06	3.96	0.14
Moderate TBI × Negativity	7.08	3.16	0.26*
ADHD total at Visit 2 with negativity at Visit 2 as moderator (n = 179)			
Untrimmed Main Effects Model			
ADHD Visit 1	0.64	0.07	0.58***
Composite income/education	−0.97	0.51	−0.14
Child's race	−1.01	1.00	−0.06
Severe TBI group	4.04	1.47	0.18***

Variable	*B*	*SE B*	β
Moderate TBI group	0.73	0.95	0.05
Time since injury	−1.32	7.73	−0.01
GCA IQ	0.04	0.03	0.09
FAD	0.06	0.45	0.01
BSI-GSI	0.01	0.04	0.01
Negativity Visit 2	−0.97	1.04	−0.06
Moderation model with nonsignificant covariates trimmed			
ADHD Visit 1	0.63	0.07	0.57***
Composite income/education	−0.74	0.47	−0.11
Child's race	−1.00	0.98	−0.06
Severe TBI group	5.83	2.52	0.26*
Moderate TBI group	0.85	2.12	0.06
Negativity Visit 2	−0.52	1.36	−0.03
Severe TBI × Negativity	−3.11	3.02	−0.12
Moderate TBI × Negativity	−0.30	2.39	−0.02
Behavioral responsiveness with negativity at Visit 2 as moderator (n = 170)			
Untrimmed main effects model			
Composite income/education	−0.05	0.04	−0.14
Child's race	−0.04	0.07	−0.05
Severe TBI group	0.00	0.10	0.00
Moderate TBI group	0.03	0.07	0.03
Time since injury	−0.14	0.54	−0.02
GCA IQ	0.01	0.00	0.30**
FAD	0.02	0.03	0.06
BSI-GSI	0.00	0.00	0.05
Negativity Visit 2	0.05	0.07	0.05
Moderation model with nonsignificant covariates trimmed			
Composite income/education	−0.06	0.04	−0.16
Child's race	−0.04	0.07	−0.04
Severe TBI group	−0.10	0.18	−0.09
Moderate TBI group	0.09	0.15	0.10
General conceptual ability	0.01	0.00	0.30**
Negativity Visit 2	0.04	0.10	0.04
Severe TBI × Negativity	0.17	0.21	0.12
Moderate TBI × Negativity	−0.07	0.17	−0.08

Note. R^2 = .67 for main effects; R^2 = .67 for moderation (R^2 change *ns*).

Note. R^2 = .61 for main effects; R^2 = .61 for moderation (R^2 change *ns*).

Note. R^2 = .40 for main effects; R^2 = .41 for moderation (R^2 change *ns*).

Note. R^2 = .02 for main effects; R^2 = .03 for moderation (total R^2 and R^2 change *ns*).

Note. R^2 = .67 for main effects; R^2 = .68 for moderation (R^2 change *ns*).

Note. R^2 = .61 for main effects; R^2 = .63 for moderation (R^2 change *ns*).

Note. R^2 = .40 for main effects; R^2 = .43 for moderation (R^2 change *ns*).

Note. R^2 = .03 for main effects; R^2 = .03 for moderation (R^2 and R^2 change *ns*).

Note. R^2 = .67 for main effects; R^2 = .68 for moderation (R^2 change *ns*).

Note. R^2 = .61 for main effects; R^2 = .61 for moderation (R^2 change *ns*).

Note. R^2 = .39 for main effects; R^2 = .44 for moderation (R^2 change, $p < .05$).

Note. R^2 = .02 for main effects; R^2 = .04 for Moderation (R^2 and R^2 change = *ns*).

Note. R^2 = .66 for main effects; R^2 = .67 for moderation (R^2 change *ns*).

Note. R^2 = .61 for main effects; R^2 = .62 for moderation (R^2 change *ns*).

Note. R^2 = .39 for main effects; R^2 = .40 for moderation (R^2 change *ns*).

Note. R^2 = .02 for main effects; R^2 = .02 for moderation (R^2 and R^2 change *ns*).

Note. CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001); ADHD = Attention-Deficit/Hyperactivity Disorder *T* score from the CBCL; GCA IQ = General Conceptual Ability Intelligence Quotient; FAD = Family Assessment Device (Miller, Bishop, Epstein, & Keitner, 1985); BSI-GSI = Brief Symptom Inventory Global Severity Index (Derogatis & Spencer, 1985).

$^{*}p$ <.05.

$^{**}p < .001$.

$^{***}p < .0001$.