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Maternal Warm Responsiveness and Negativity Following Traumatic Brain Injury in Young Children

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Abstract

Purpose/Objective—To understand how traumatic brain injury (TBI) affects maternal warm responsiveness and negativity over the first 12 months following injury.

Method/Design—We used a concurrent cohort research design to examine dyadic interactions in young children with a TBI ($n = 78$) and a comparison group of young children with orthopedic injuries (OI; $n = 112$) and their families during the initial weeks following injury (i.e., baseline) and at two follow-up periods (approximately 6 and 12 months later). Trained raters coded videotaped interactions during a free play and structured teaching task for maternal warm responsiveness and negativity.

Results—Mothers in the complicated mild/moderate TBI group, but not those in the severe TBI group, exhibited significantly lower levels of maternal warm responsiveness than mothers in the OI group. However, these differences were observed only at baseline during free play and only at baseline and 6 months postinjury during the structured teaching task, suggesting diminishing

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adverse effects of complicated mild/moderate TBI on parenting over time postinjury. Analysis failed to reveal group differences in maternal negativity at any of the assessments. Across groups, lower socioeconomic status (SES) was associated with lower levels of warm responsiveness and higher levels of negativity.

Conclusions/Implications—These findings, though preliminary, indicate possible alterations in mother–child interactions in the months following a TBI.

Keywords

mother–child interactions; traumatic brain injury; early childhood; direct observation; longitudinal study

Traumatic brain injury (TBI) in childhood often results in significant challenges for children and their families. Following a TBI, children are at increased risks for cognitive, academic, behavioral, and adaptive deficits, although children who sustain a severe TBI appear to be at the highest risk for negative consequences (Anderson, Morse, Cartroppa, Haritou, & Rosenfeld, 2004; Fay et al., 2009; Taylor et al., 2002). Given the breadth of problems that children with a TBI frequently encounter, it is not surprising that TBI commonly creates strain for caregivers and the family as a whole. Parents of children with TBI tend to report higher rates of overall burden relative to parents of children with orthopedic injuries (OI) (Stancin, Wade, Walz, Yeates, & Taylor, 2008; Taylor et al., 2001; Wade et al., 2002) and parents of uninjured children (Hawley, Ward, Magnay, & Long, 2003). Furthermore, studies of pediatric TBI have found caregivers are at increased risk for stress, psychological problems, marital strain, interference with daily routines, and family dysfunction (Aitken et al., 2009; Hawley et al., 2003; Rivara et al., 1992; Stancin et al., 2008; Wade et al., 2002). A review of siblings of children with traumatic brain injury indicated that the uninjured siblings may be at increased risk for poor psychological outcomes when the child with a TBI has ongoing behavioral problems (Sambuco, Brookes, & Lah, 2008).

Family functioning is important to consider in pediatric TBI, as it has been shown to predict outcomes (Anderson, Godfrey, Rosenfeld, & Catroppa, 2012; Kurowski et al., 2011; Taylor et al., 2001). Taylor and colleagues (2001) found evidence of a reciprocal relationship over time between the child's behavior and the family's functioning following severe TBI. More specifically, the presence of more child behavioral problems at 6 months post injury predicted higher family burden at 12 months, whereas higher ratings of parental distress at 6 months predicted more child behavior problems at 12 months postinjury. It is especially notable that these results were found after controlling for preinjury functioning in both domains. Given this association between family functioning and child behavior, it seems important to consider the parent–child relationship in the process of recovery.

Extant research demonstrates that positive parenting in early childhood is associated with favorable social-emotional, cognitive, and behavioral development in typically developing children (Ainsworth, Blehar, Waters, & Wall, 1978; Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003; Bradley, Corwyn, Burchinal, McAdoo, & Garcia-Coll, 2001; Glascoe & Leews, 2010; Zhou et al., 2002). In particular, parental warmth and responsiveness, defined as consistent, prompt, contingent, and appropriate reactions to the

child that are supportive in quality (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Landry et al., 2012; Landry, Smith, Swank, Assel, & Vellet, 2001), has been linked to behavioral regulation, compliance, and a reduced incidence of externalizing behaviors (Jones et al., 2008; Jennings et al., 2008; Rothbaum & Weisz, 1994; von Suchodoletz, Trommsdorff, & Heikamp, 2011; Wahler & Meginnis, 1997). Parental warmth might also serve as a protective factor in the presence of familial stressors. McFarlane et al. (2010) found that higher levels of parental warmth at 1 year of age were associated with lower teacher ratings for peer rejection, concentration problems, and shyness in first grade among children at psychosocial risk.

Whereas positive parenting practices have been associated with beneficial behavioral outcomes, harsh or negative parenting practices that involve criticism and punitive discipline have been shown to contribute to an increased likelihood of developing disruptive behaviors as well as reduced self-regulation abilities (Ackerman, Brown, & Izard, 2003; Bradley & Corwyn, 2007; Deater-Deckard, Dodge, Bates, & Pettit, 1998; Gershoff, 2002; Kochanska, Aksan, & Nichols, 2003). In a large study of 631 children with disruptive behaviors, Stormshak, Bierman, McMahon, and Lengua (2000) found that punitive discipline strategies predicted oppositional, aggressive, hyperactive, and internalizing behaviors. Additionally, Hoeve and colleagues (2009) estimated the rate of children scoring high on delinquency in rejecting/hostile environments was double that of children living in households with minimal or no rejection/hostility (i.e., 67% vs. 33%).

Positive parenting practices have been demonstrated to play a key role in development and behavioral outcomes in typically developing children; however, less is known about how parenting practices affect children who are medically at risk. In children with TBI, who are at increased risk for behavioral problems, parent-child interactions may be even more influential on behavioral outcomes (Wade et al., 2011). The findings of this report will expand upon an earlier study (Wade et al., 2008) that examined parent-child interactions in a play context during the initial weeks following brain injury in young children. In the previous study, parents of children with a complicated mild TBI demonstrated lower levels of warm responsiveness during a free play and teaching task, as compared to parents of children in the OI group. The parents of children with a moderate TBI were rated as less responsive than those of children with OI only during the teaching task. There were no differences between the severe TBI and OI group on either the free play or teaching task.

In the present study, we examined the longitudinal effects of brain injury on mother-child interactions shortly after injury and at two follow-up periods (approximately 6 and 12 months postinjury) in this sample. Based on the recent findings highlighting the significance of parental warmth and responsiveness, as well as parental negativity (Wade et al., 2011), we chose to focus exclusively on these variables. Consistent with prior research, we divided the TBI group into severe versus complicated mild/moderate TBI. Existing research suggests that severe TBI is often significantly different from both moderate and complicated mild TBI, particularly in the area of family functioning, as adverse outcomes tend to be greater and persist for longer periods of time in cases of a severe TBI (Anderson, Morse, Catroppa, Haritou, & Rosenfeld, 2005; Hawley et al., 2003; Stancin, Wade, Walz, Yeates, & Taylor, 2010; Wade et al., 2002). Additionally, moderate and complicated TBI injuries often

show a more similar pattern of outcomes (Kashluba, Hanks, Casey, & Millis, 2008). In view of evidence for persistent behavior problems in children with TBI along with long-term family burden (Fay et al., 2009; Wade et al., 2006), we hypothesized that both TBI groups would experience more adverse outcomes with respect to parent–child interactions throughout the first year postinjury relative to an age-matched cohort of children with orthopedic injuries, with more pronounced differences following a severe TBI. We further hypothesized that both TBI groups would demonstrate a decline in warm responsiveness over time and, conversely, an increase in negativity over time relative to an age-matched cohort of children with OI, again with the expectation of more pronounced differences following a severe TBI. Research involving parent–child interactions has demonstrated that the parent–child relationship experiences more stress in a structured as opposed to a nonstructured task (Healey, Gopin, Grossman, Campbell, & Halperin, 2010; Wade et al., 2008; Barkley, Karlsson, & Pollard, 1985). Hence, we also anticipated that maternal warm responsiveness would be lower in the teaching task. This study reports among the first observational data of changes in parent–child interactions over the initial year post-TBI relative to children who sustained an OI. Extant research has shown that TBI in children is associated with negative outcomes for family functioning; however, these studies have relied exclusively on indirect methods of assessment, such as rating scales. Although these methods provide useful information, social desirability can influence the accuracy of information provided. Direct observation procedures provide firsthand examples of the target behavior in question.

Method

The study used a concurrent cohort research design to examine dyadic interactions in young children with a TBI and a comparison group of young children with OI and their families during the initial weeks following injury (i.e., baseline) and at two follow-up periods (approximately 6 and 12 months later). Including children with OI as a comparison group allowed us to consider the effects of TBI relative to the functioning of a group of children who were likely to share preinjury behavioral characteristics and associated risk factors. Additionally, the use of an OI cohort likened the groups with respect to the family stressor of having a child hospitalized. 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 preschool children with a TBI or OI that did not involve the central nervous system (CNS) were screened at three tertiary care children's hospitals and a general hospital (all with Level I trauma centers). Eligibility requirements for both groups included: injury age between 36 and 84 months and English as the primary spoken language in the home. Additional criteria for patients with TBI were: a TBI requiring overnight hospitalization with a Glasgow Coma Scale of 12 or less or a higher score accompanied by abnormalities on imaging (MRI or CT) scans. 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 a brain injury (e.g., symptoms of concussion). Exclusionary criteria for both groups were: a previous history of brain injury; preexisting neurological disorder or medical problem affecting the CNS; a diagnosis of intellectual disability, autism, or neurological disorder; documentation in the medical chart or in the parent interview of child abuse as the cause of injury; and history of a severe psychiatric disorder requiring hospitalization.

Sample Characteristics

A total of 206 children and their caregivers (TBI = 87 and OI = 119) completed informed consent and were enrolled in the study. Baseline data were collected on 204 children and caregivers (TBI = 87 and OI = 117). The sample included 54% of potentially eligible children with TBI and 35% of eligible children with OI. Comparison of enrolled children to 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). Approximately 70% of the sample completed the 12-month postinjury assessment resulting in complete data for a total of 69 children with TBI and 74 children with OI. However, because the hypotheses were tested using general linear mixed models analyses, 190 dyads with usable data from at least one assessment were included in the final models. Participants were removed from analyses when the informant was not the mother ($n = 10$), or when parent-child interactions were not observed at any of the three assessments ($n = 6$). Completers ($n = 190$) did not differ from noncompleters ($n = 16$) with respect to total hospitalization days, ISS score, child age at injury, parental education, child race, or child gender. Groups were significantly different with respect to parental age, wherein the completers ($M = 31.99$, $SD = 6.09$) were younger in age than the noncompleters ($M = 38.75$, $SD = 10.46$).

Table 1 presents the injury and demographic characteristics of the 190 children who were included in the mixed models analyses. Consistent with previous investigations (Fletcher, Ewings-Cobbs, Miner, Levin, & Eisenberg, 1990), severe TBI was defined as one resulting in a GCS score of 8 or less at any point since injury and the complicated mild/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). Simple skull fractures without associated findings were not considered to be complicated mild injuries. 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 groups also differed significantly with respect to parental education and family income. The OI group earned higher family incomes and was more likely to obtain education beyond high school than the severe TBI group. As reported in the original study (Wade et al., 2008), the TBI and OI groups did not differ from each other with respect to preinjury delays in growth and development (9% TBI and 10% OI), learning difficulties (3% TBI and 3% OI), emotion or behavior problems (7% TBI and 3% OI), or previous developmental evaluation (16% TBI and 18% OI). In addition, the TBI and OI groups did not differ from each other with respect to ratings of preinjury parenting style (authoritarian, authoritative, or permissive) or total child behavior problems on the Child Behavior Checklist (all $ps = .20$). These data suggest

that the TBI and OI groups did not differ with respect to preinjury child or parenting characteristics.

Measures

Ratings of parent behavior—To rate parent and child behaviors, we employed the coding system used by Landry and colleagues in their studies of outcomes in low birth weight children (Landry, Smith, Miller-Loncar, & Swank, 1997). 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 et al., 2001, 1997; Landry, Miller-Loncar, Smith, & Swank, 2002). Parent behavior was coded along the dimensions of warmth, contingent responsiveness, and negativity. *Parental warmth* was rated based on the presence and intensity of verbal and nonverbal warmth, affection, and positive regard toward the child as characterized by physical engagement and proximity, encouragement and praise, positive conversation, enthusiasm, physical affection, and a sense of joy and pleasure in interacting with the child. Contingent responsiveness reflected the parent's sensitivity and responsiveness to the child's behavior (see Wade et al., 2008 for a more complete description). Due to a significant correlation between these two scales, warmth and contingent responsiveness were averaged into a single scale of warm responsiveness that reflects positive parenting behavior (see also Landry, Smith, & Swank, 2006). Each dimension was rated along a 5-point scale with higher scores indicating more warm-responsiveness. A 5 indicates a parent who is almost always warm verbally and nonverbally and who exhibits no negative behaviors, whereas a 1 reflects a parent who shows minimal to no warmth. Landry and colleagues have previously referred to low warm responsiveness as below a 3 (Landry et al., 2001), wherein a 3 is defined as showing warm responsiveness during half of the total observation time and a neutral stance the other half. Negativity was rated on the basis on 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 and sighing). As with warm responsiveness, higher ratings reflected more positive behavior.

Procedures

Parent-child dyads were videotaped during a 10-min free play and teaching task sessions, each of which was divided into two 5-min segments for rating purposes and transcribed to facilitate coding of caregiver and child verbalizations. During the free play interactions, parents and children were instructed to spend time together as they normally would at home. Children in the free play situation were able to engage in enjoyable activities with opportunities for interaction with their parent in the absence of any stated expectations for performance. The room was equipped with developmentally appropriate toys, a TV, and magazines for the parent to read. The free play situation was designed to elicit parent-child interactions similar to those that might be observed in the child's home or other everyday situation, thereby increasing ecological validity. In contrast, the teaching task involved having parents and children complete a series of puzzles together that were selected based on the likelihood of needing some parental assistance.

Analyses

We used mixed models analyses to examine changes in parental warm responsiveness over time in children with TBI compared to OI. Mixed model analyses were employed because they allow flexible longitudinal modeling of the pattern of change in outcomes over time. In particular, mixed model analysis makes use of all the data for a given participant, even if that individual is not seen at all assessments or if assessment intervals are unevenly spaced. Separate analyses were conducted examining changes in warm responsiveness during free play and parent-directed activity that are depicted in Tables 2 and 3. Ratings of parental negativity were highly skewed with most parents rated as displaying little or no negativity. To address this issue, ratings of negativity were dichotomized into any versus no negativity and general estimating equations (GEE) were used to examine changes in the proportion of each group rated as displaying negativity over time during free play or teaching. Covariates in each of these models included the caregiver's race and the family's socioeconomic status. We estimated the main effects of each of the covariates. In addition, we examined the main effects of injury type/severity (OI, Complicated Mild/Moderate TBI, Severe TBI) and time since injury as well as the interaction of injury severity and time since injury. Similar to Tomblin, Mainela-Arnold, and Zhang (2007), nonsignificant interactions were eliminated and the models were reestimated. We used an alpha of 0.05 to determine significance effects. When group $\times$ time interactions were significant, we reported the relevant contrasts among groups at each time point.

Results

Warm Responsiveness

Mixed model analyses of warm responsiveness during free play over time revealed a significant group $\times$ time interaction, $F(2, 166) = 4.54, p = .01$. Examination of group contrasts at each time point, revealed significantly lower levels of warm responsiveness in parents of children with complicated mild/moderate TBI at baseline relative to parents of children with OI, $t(282) = -3.01, p = .003$, but not at 6 or 12 months post injury (see Figure 1). There were no differences in parental warm responsiveness between the parents of children with severe TBI and OI at any time point. Notably, the severe TBI and OI group demonstrate a decline in maternal warm responsiveness, whereas the moderate TBI group remains low in maternal warm responsiveness. There were significant main effects for both parental race and SES with non-White parents and those of lower SES rated as displaying lower levels of warm responsiveness.

Examination of changes in warm responsiveness over time in a structured teaching task also revealed a significant group $\times$ time interaction, $F(2, 167) = 5.55, p = .005$. As depicted in Figure 2, after controlling for race and SES, parents of children with complicated mild/moderate TBI were rated as displaying significantly less warm responsiveness at both baseline and 6 months than parents of children with OI, $t(283) = -4.18, p = .001$; and $t(175) = -2.83, p = .005$, respectively. The severe and complicated mild/moderate TBI group remained low in maternal warm responsiveness, whereas, the OI group demonstrated a decline in maternal warm responsiveness over time. There were no differences among the groups at 12 months postinjury and there were no differences between the severe TBI and

OI groups at any point postinjury. We also found significant main effects for caregiver race and SES, with effects similar to those noted for the free play models.

Negativity

GEE analyses of negativity over time during free play, revealed that as time increases the odds of negativity decrease (Adjusted Odds Ratio = 0.56 $Z = -2.26$, $p = .02$) controlling for race and SES. Parental negativity did not differ by injury group and there were no interaction effects. Similarly, analyses of parental negativity during the teaching task revealed only main effects for time since injury, (Adjusted Odds Ratio = 0.39 $Z = -3.88$, $p = .00001$) controlling for race and SES. Over time, parents were less likely to display negativity during teaching regardless of the nature of the child's injury.

Discussion

This study provides among the first observational evidence of alterations in parent-child interactions during the first year following TBI. Compared to parent-child dyads following orthopedic injuries, parent-child dyads following a complicated mild/moderate TBI demonstrated lower levels of warm responsiveness at baseline during free play and at both baseline and 6 months postinjury during structured activities. These differences, however, appeared to resolve by 12 months postinjury. Contrary to expectations, no significant differences emerged between the severe TBI and OI group at any time point. One possible explanation for these differences is that the severe TBI group was small, resulting in inadequate power during the first two observations. Another possibility is that parents may view children with a complicated mild/moderate TBI as back to normal in the initial months post injury and have higher expectations for the child's behavior and performance, whereas children with severe TBI have more apparent deficits that result in lowered parental expectations. Due to these differing expectations, parents of children with complicated mild/moderate TBI may exhibit less warmth and responsiveness toward the child. These differences in warmth may be most apparent during the teaching task when parents have additional demands for child performance and consequently fewer opportunities for positive interactions. These findings are also similar to those reported by Wade et al. (2006), who found higher levels of parental psychological distress in the moderate TBI group as compared to the OI group, with no differences emerging between the severe TBI and OI groups for distress. Although extant research generally indicates that children with a severe TBI and their families experience the most adverse psychosocial outcomes, this study highlights the importance of assessing for negative outcomes in those with less severe injuries.

A further consideration in this study is the differential changes in groups over time. By 12 months, all three groups appear to demonstrate similar parent-child interactions, in that all groups are showing low levels of warm responsiveness in both the play and teaching condition. Closer scrutiny of the slopes in the play condition reveals that the moderate TBI group remains low across time points, whereas the OI and severe TBI group demonstrate declining slopes. The influences of social desirability could be one factor that influenced behavior in these groups. Initially, parents might have felt some pressure to engage in more

positive interactions in the presence of others but became less concerned about these interactions as time progressed. As Gardner (2000) suggests, if observer reactivity is present, the initial session would be expected to appear less representative of parent–child interactions than later sessions since the effects of reactivity would be expected to diminish over time as participants habituate to the situation. For example, Shanley and Niec (2011) found that parents who were observed during two analogue observations of child-led play, one of which was a warm-up to allow parents and children to acclimate to the environment, revealed parents engaged in less negative talk during the warm-up observation. It is possible that social desirability is obscuring actual differences in this study that exist between the severe TBI and OI group during the play condition.

In contrast, it is noteworthy that both the complicated mild/moderate and severe TBI group demonstrate low levels of maternal warm responsiveness across time in the teaching condition, whereas the OI group continues to demonstrate a declining slope. The differing expectations in these two conditions may explain why the severe TBI group is no longer able to maintain the level of positive interactions that were present during the play condition. Parent–child dyads had a goal of completing a puzzle in the teaching task, which is in contrast to the play condition that involved no expectations for child performance. This condition may be a better representation of the frustrations families encounter when children with a severe TBI are expected to follow directions at home.

With regards to parental negativity, these findings were not consistent with our hypothesis of a specific injury effect. Rather than finding increases in parental negativity in the TBI groups exclusively, a general effect for time was found with negativity decreasing significantly over time among all groups. These results were somewhat unexpected as research tends to show that children with a TBI and their families generally fare worse in terms of family functioning/adaptation relative to their orthopedic injury counterparts, particularly in cases of a severe TBI (Stancin et al., 2008; Wade et al., 2006). Reductions in negativity in the sample as a whole may be attributable to developmental changes in the sample as a whole. As children move further from toddlerhood, parents may be less inclined to respond sharply. Given the low frequency of negative behaviors in the sample as a whole, it is possible that our measure of negativity failed to capture the more subtle changes in family dynamics that may accompany TBI. Parental control and direction may be more sensitive markers of changes in family dynamics that may accompany TBI.

Interestingly, race and income were associated with parental negativity and warm responsiveness in this study, consistent with previous studies that document a relationship between social and demographic characteristics and family functioning following TBI (Barry, Taylor, Klein, & Yeates, 1996; Yeates et al., 2002). However, caution is warranted when comparing parenting behaviors between races. There is evidence that measures used to assess parenting behaviors may not be equivalent across groups, thereby leading to a higher likelihood of erroneous interpretations (Raver, Gershoff, & Aber, 2007). Nevertheless, our findings might have important implications in light of research with cumulative risk factors and childhood adjustment. Children confronted with multiple psychosocial risk factors, such as economic disadvantage, are at greater risk for behavioral problems (Ackerman, Brown, & Izard, 2004; Appleyard, Egeland, van Dulmen, & Sroufe, 2005); however, parenting factors

can mediate the relationship between risk factors and child outcomes (Ackerman, Izard, Schoff, Youngstrom, & Kogos, 1999). Trentacosta and colleagues (2008) found that cumulative risk factors predicted nurturant and involved parenting, which in turn predicted externalizing behaviors at age 4. The effects of cumulative risk on family burden over time have also been studied in children with pediatric TBI. Although a total cumulative risk index factor explained more variance with respect to family burden than any of the individual domains, it was noteworthy that family risk factors explained 10% and 12% of the variance in family burden at baseline and 4 years, respectively (Josie et al., 2008).

Most importantly, the association between nurturant and involved parenting with optimal development and, more specifically, emerging behavior problems is not only relevant to a noninjury group but has also been shown to extend to pediatric TBI. Higher levels of warm responsiveness were found to ameliorate the effects of pediatric TBI on behavioral adjustment, including symptoms of ADHD (Wade et al., 2011). Less optimal parenting styles also resulted in increased behavioral problems and executive dysfunction in young children with a TBI (see Yeates, Taylor, Walz, Stancin, & Wade, 2010; Potter et al., 2011), as well as reduced adaptive functioning in children and adolescents with a TBI (Micklewright, King, O'Toole, Henrich, & Floyd, 2012).

Given the importance of positive parenting on childhood behavior, it is notable that parents of children with a complicated mild/moderate TBI yielded lower levels of warm responsiveness throughout this study; however, significant differences were no longer detected between groups by 12 months. Since a rating of a 3 indicates that mothers engaged in warm behaviors half of the total observation time and neutral behaviors during the other half, the complicated mild/moderate TBI group consistently demonstrated suboptimal levels of warm responsiveness (average rating for warm responsiveness was approximately 2.6). However, all three groups had suboptimal levels of warmth at 6- and 12-month follow-ups, suggesting that parents were missing opportunities to engage in positive interactions with their children. Presumably, enhancing parental warm responsiveness could result in improved behavioral outcomes, particularly among those at increased risk for behavior problems. Emerging research has begun demonstrating that teaching positive parenting skills improves behavioral outcome in children with a TBI (Cohen, Heaton, Ginn, & Eyberg, 2012; Wade, Oberjohn, Burkhardt, & Greenburg, 2009), although more research is clearly needed in this area.

As the time since injury is still relatively short in this study, further research would be helpful to elucidate the long-term effects of TBI on maternal warm responsiveness and negativity. Indeed, there is some evidence that the quality of the parent-child relationship might be vulnerable to changes many years after the initial injury, particularly with the approach of adolescence (Wade et al., 2006). Despite an absence of differences at 12 months after injury between the severe TBI and OI groups, Wade and colleagues (2006) found that the severe TBI group reported significantly worse family functioning 4–5 years after the initial injury than the OI group. Similarly, observations of Parent-adolescent interactions years after injury revealed that negativity (i.e., criticism/coldness) was related to family functioning (Wade et al., 2003). With the transition to adolescence, families in this study will likely be faced with new challenges as these children begin the process of seeking

increased autonomy. Therefore, a lack of significant differences between groups on the variables of maternal warmth and negativity at 12 months in this sample does not preclude the possibility of differences emerging over the course of time.

Some limitations are present in the current study. Although the coding system has been extensively used and predictive validity of these ratings for subsequent child cognitive and social development has been reported (Landry et al., 2001, 1997, 2002), the scale has not been standardized. Placing these findings into context becomes more problematic when there is no average rating with which to compare the present results. As the scale is based on ordinal data, the distinction between neighboring points on the scale is not necessarily the same from one value to the next. It might be worthwhile to consider other coding systems such as interval coding, which would ensure that values assigned to families were uniform across participants. Finally, the present report sought to elucidate parent–child interactions over time following a TBI, and not the association between parent–child interactions and child behavioral outcomes.

Overall, these findings suggest that parent–child interactions may be affected in the first several months following a TBI, particularly following a complicated mild/moderate TBI. As indicated, previous evidence suggests that levels of warm responsiveness and negativity are associated with short-term behavioral outcomes in pediatric TBI (Wade et al., 2011), and recent studies document improved behavioral outcomes from teaching positive parenting skills (Cohen et al., 2012; Wade et al., 2009). The question emerges whether this study demonstrates a resolution of the negative effects of TBI over time, at least for the complicated mild/moderate TBI group, or perhaps an obscuring of the effect in the context of social desirability or normative decreases in positive parenting interactions. In the case of the latter condition, families could benefit from a brief assessment of parent–child interactions to identify whether intervention might be useful in the child’s recovery process from TBI.

Finally, this study looked solely at interactions between mothers and children following a TBI. A recent study indicates fathers of children with TBI hold different perspectives on family functioning and the rate of parenting disagreements that occur as compared to mothers (Bendikas, Wade, Cassidy, Taylor, & Yeates, 2011). Furthermore, father involvement has proven beneficial in maintaining treatment gains for behavioral outcomes (Bagner & Eyberg, 2003). Future studies should consider investigating interactions between fathers and children, as this relationship also provides important contributions to family functioning following a TBI. Additionally, future investigations should consider the relationship of parent–child interactions to the emergence and maintenance of behavior problems over time and especially during key transition periods such as school entry. Further direct observational studies at varying times postinjury are warranted as they provide a unique glimpse into parent–child interactions that are not afforded by indirect methods of assessment such as parent report.

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Impact and Implications Statement

- The majority of research in pediatric TBI has focused on investigating changes in family functioning by means of indirect assessment. The current study is among the first to conduct direct observations longitudinally in parent–child interactions post TBI.
- This study provides evidence that the quality of the relationship between mothers and children might be affected in the months following a TBI.
- This study suggests that clinicians may want to identify parents who experience changes in their interactions with their child to facilitate the subsequent recovery process from TBI.

Figure 1.

Group by time interactions for maternal warm responsiveness during the play task across the first year postinjury. Mothers of children with a moderate TBI demonstrated significantly lower levels of maternal warm responsiveness at baseline relative to mothers of children with an orthopedic injury. There were no differences among the groups at 6 months or 12 months.

Figure 2.

Group by time interactions for maternal warm responsiveness during the teaching task across the first year postinjury. Mothers of children with a moderate TBI demonstrated significantly lower levels of warm responsiveness at baseline and 6 months relative to mothers of children with an orthopedic injury. There were no differences among groups at 12 months.

Table 1

Participant Characteristics by Group

Characteristic	Severe TBI (n = 21)	Moderate TBI (n = 59)	OI (n = 116)	Group comparisons
Maternal education high school	15 (78.9%)	33 (55.9%)	54 (46.6%)	Sev < OI*
Family income	\$51,940 ± 12,888	\$58,984 ± 25,953	\$64,092 ± 23,648	Sev < OI*
% Male	14 (66.6%)	35 (59.3%)	67 (57.8%)	n/s
% Non-White	7 (36.8%)	19 (32.2%)	28 (24.1%)	n/s
Age at injury	5.06 ± 1.00	4.98 ± 1.21	5.10 ± 1.08	n/s
ISS score	13.68 ± 8.81	15.47 ± 7.89	6.98 ± 2.67	Sev < Mod*** Mod < OI***
Total hospital days	10.09 ± 19.71	2.53 ± 1.9	1.33 ± 1.02	Sev < Mod*** Mod < OI***

Note. TBI = traumatic brain injury; OI = orthopedic injury; ISS = injury severity score.

*
p < .05

p < .001.

Table 2

Warm Play by Group and Time

Variable	Estimate	St. Error	t Value	Pr > t
Group				
Severe	.0356	.2228	.16	.8731
Moderate	−0.4681	0.1478	−3.17	0.0017
OI	0.0000	.	.	.
Race				
Non-White	−0.4190	0.1487	−2.82	0.0053
White	0.0000	.	.	.
Socioeconomic status	0.2433	0.0606	4.02	<.0001
Time since injury	−0.2767	0.0862	−3.21	0.0016
Time since injury by group				
Severe by TSI	−0.0520	0.2106	−.25	0.8052
Moderate by TSI	0.4236	0.1439	2.94	0.0037
OI by TSI	0.0000	.	.	.

Note. TSI = time since injury.

Table 3

Warm Teaching by Group and Time

Variable	Estimate	St. Error	t Value	Pr > t
Group				
Severe	−0.2548	0.2153	−1.18	0.2375
Moderate	−0.6111	0.1442	−4.24	<.0001
OI	0.0000	.	.	.
Race				
Non-White	−0.3560	0.1415	−2.52	0.0127
White	0.0000	.	.	.
Socioeconomic status	0.2473	0.0578	4.28	<.0001
Time since injury	−0.4516	0.0884	−5.11	<.0001
Time since injury by group				
Severe by TSI	0.2511	0.2137	1.17	0.2417
Moderate by TSI	0.4701	0.1489	3.16	0.0019
OI by TSI	0.0000	.	.	.

Note. TSI = time since injury.