How do mothers and fathers interact with their children post-injury? Exploring the role of parental acute stress, optimism and self-efficacy

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Abstract

Objective: In the aftermath of a child injury, children and parents can jointly experience acute stress symptoms. Optimism and self-efficacy might buffer against posttraumatic stress disorder. Knowing that children are innately receptive to parent modelling, we were interested in exploring how parent acute stress, optimism and self-efficacy might transpire in parent-child interactions and whether any differences existed between mothers and fathers.

Methods: We recruited 71 families of seriously injured children who were hospitalized for at least 24 hours. Parents completed self-report measures of acute stress, optimism and self-efficacy. Children wore the Electronically Activated Recorder (EAR; Mehl, 2017) for a two-day period post-discharge. The EAR recorded ambient sounds for 30 seconds every 5 minutes. The audio recordings were transcribed and coded. We derived a percentage of time spent with each parent (interaction time), and average ratings of the emotional tone of voice for each speaker.

Results: Overall, parental acute stress and self-efficacy were not associated with interaction time or emotional tone, and parents generally spent less time with older children. Compared to fathers, mothers spent significantly more time with their child, particularly for daughters, but mothers did not differ from fathers in emotional tone, acute stress, optimism or self-efficacy. For mothers, optimism may be associated with greater interaction time and more positive emotional tone.

Conclusions: The present study highlighted parent gender differences in time spent with children and enabled the inclusion of more fathers using a naturalistic observational tool.

A child's serious injury can precipitate a stressful time for parents as well as children (Muscara et al., 2018). In addition to the physical and practical repercussions, parents may be coping with their own emotional reactions while aiming to support their child (Kassam-Adams, Fleisher, & Winston, 2009). In some cases, symptoms of Acute Stress Disorder may develop, within a month post-trauma (American Psychiatric Association, 2013). Child and parent traumatic stress symptoms tend to covary, and parents' distress following child injury is thought to influence children's psychosocial recovery (Alisic, Jongmans, van Wesel & Kleber, 2011; Morris, Gabert-Quillen, & Delahanty, 2012; Wise & Delahanty, 2017).

Recently, there has been interest in the influence of optimism (i.e. positive expectations about the future; Scheier & Carver, 1987; Dougall, Hyman, Hayward, McFeeley, & Baum, 2001) and self-efficacy (i.e. perception of sufficient resources to manage the personal and practical demands of the situation; Benight & Bandura, 2004). Optimism and self-efficacy may buffer against the development of posttraumatic stress in adults (Benight & Harper, 2002; Birkeland, Blix, Solberg, & Heir, 2017; Jakšić, Brajković, Ivezić, Topić, & Jakovljević, 2012), and influence how parents manifest their distress and their ability to "be there" for their child, potentially protecting against child traumatic stress (Jones & Prinz, 2005; Kurtz-Nelson & McIntyre, 2017).

While it is established that parents model a wide range of behaviours to their children, likely including coping and emotion regulation strategies (Morris, Silk, Steinberg, Myers, & Robinson, 2007), it is unclear exactly how acute stress, optimism and self-efficacy might manifest in daily interactions. It is possible that parents who are less stressed, and more confident in their own sense of competency and expectations for the future, might demonstrate this in their interactions with their child.

It could be hypothesised that parents who are traumatised by their child's injury might also avoid reminders of the event (American Psychiatric Association, 2013), including interactions with their child. It is also possible that parents who are less confident in their abilities and less hopeful about the future in general, see less of a purpose to their interactions with their child and might therefore interact less. Emotional tone of voice is another understudied, but potentially influential aspect of parent-child interactions that may capture subtle emotional shifts within a conversation (DeBoer et al., 2017). Positive parental emotional tone (e.g. warmth) can promote coping, emotion regulation and adjustment into adulthood (Moran, Turiano, & Gentzler, 2018). Therefore, parents' emotional tone of voice and interaction time with their children warrant further investigation in the context of psychosocial recovery.

While both parents likely play a role in their child's recovery, we know little about fathers; mothers tend to participate in greater numbers in research studies (Muscara et al., 2018; Shudy et al., 2006). Furthermore, when fathers are included, there appear to be differences in their reported distress and in how they support their children, compared to mothers. In line with overall gender differences in adults (Tolin & Foa, 2006), mothers tend to report more traumatic stress symptoms than fathers (Holt, Jensen, Dyb, & Wentzel-Larsen, 2017; Tifferet, Manor, Constantini, Friedman, & Elizur, 2011). A meta-analysis further indicated a stronger relationship between child and maternal traumatic stress, compared to child and paternal traumatic stress (Morris et al., 2012).

A possible explanation for these differences in stress between mothers and fathers is that the relationship between parent and child traumatic stress occurs via parent-child interactions (Gil-Rivas, Holman, & Silver, 2004; Snyder et al., 2016; Williamson et al., 2017) and that these interactions differ for mothers and fathers. For example, consistent with gender roles in parenting, mothers may simply be around more often, more engaged in caregiving

duties and therefore more exposed to their child's distress, with a greater opportunity for influence (Australian Institute of Family Studies, 2009; Holt et al., 2017; Milkie, Nomaguchi, & Denny, 2015). In addition, compared to fathers, mothers may be more likely to encourage children to elaborate on their memories of the event and emotionally support their children in processing their distress (Manczak et al., 2016; Zaman & Fivush, 2013). Apart from parent gender, the age and gender of the child likely influence both parent-child interactions and traumatic stress (Åman-Back, & Björkqvist, 2004; Wise & Delahanty, 2017). Younger children may be especially responsive to parent modelling and thus sensitive to parent stress. Younger children may also be more likely to take what is said literally and miss emotional tone of voice (Friend, 2003).

Despite the potential importance of parent-child interactions, it is difficult to request parents to report on their own oft automatic or unnoticed ways of interacting (Alisic, Barrett, Bowles, Conroy & Mehl, 2016; Mehl, Robbins, & Deters, 2012). Furthermore, observation remains the "gold standard" for studying interactions (Williamson et al., 2017) but can be costly and time-consuming. In order to study parent-child interactions naturalistically, the present study used an ecological momentary assessment app, the Electronically Activated Recorder (EAR; Mehl, 2017; Mehl et al., 2012; Mehl, Pennebaker, Crow, Dabbs & Price, 2001). The EAR imperceptibly and automatically records ambient audio data at regular intervals. The EAR has been used to capture audible behavior and interactions for a variety of populations in the context of trauma and health issues (e.g. Karan, Wright, & Robbins, 2017; Mehl & Pennebaker, 2003; Mehl et al., 2012; Tobin et al., 2014).

Therefore, the present study aimed to:

1. Explore behavioral markers of parental acute stress, optimism and self-efficacy via associations with interaction time and emotional tone.

2. Explore parent gender differences in acute stress, optimism, self-efficacy, interaction time and emotional tone.

Based on past research, we expected that mothers would be more stressed in the aftermath of a child's serious injury and interact more with their children than fathers. We did not hypothesise parent gender differences in optimism, self-efficacy and emotional tone, due to the lack of consensus within the literature. However, we hypothesised that, in keeping with the potential buffering effects of optimism and self-efficacy, parents who reported fewer acute stress symptoms, and greater optimism and self-efficacy would have more and more positive interactions with their child.

Method

The present study is part of the Ear for Recovery study, conducted through the Royal Children's Hospital in Melbourne, Australia (Alisic et al., 2015). The study was approved by the Human Research Ethics Committee of the Royal Children's Hospital Melbourne (study number 33103) and Monash University Human Research Ethics Committee (file number CF13/2515-2013001322).

Participants

We approached families of seriously injured children aged between 3 and 16 years who had been hospitalized at the Royal Children's Hospital for at least 24 hours. Families were ineligible if the child's injury was due to child abuse, self-harm, or an existing medical condition or if the child was hospitalized for more than four weeks. The potential range of hospital stay was 1 to 28 days, to capture the acute period post-trauma. Families were also required to mainly speak English at home, for the purposes of transcription of recordings in English. Of the 99 families who provided written informed consent, 71 families with valid

EAR data were included in the current analyses (see Alisic et al., 2017 for full recruitment details).

While most of the families included both parents, a subset of the sample included 11 single-parent households (15.49% of the total sample), three (4.23%) with one parent and one step-parent, and one participant with a different living situation (1.41%). Overall, 69 female and 63 male caregivers were involved in EAR recordings, henceforth referred to as mothers and fathers for ease of reading. Of these, 64 mothers (92.75%) and 31 fathers (49.21%) returned at least two questionnaires (described below). Fathers who did not return questionnaires spent significantly less time with their child (M = 6.71% wake time, SD = 6.91%) than those who did (M = 15.60% wake time, SD = 11.24%), $t(49.54) = -3.77$, $p < .001$. Otherwise, participating and non-participating parents did not differ in their child's age or injury severity and there were no differences in interaction time for participating and non-participating mothers. Out of an eligible 53 children over the age of 8, 48 (90.57%) completed their questionnaire.

Measures

Child demographics and injury severity. Demographics and child injury severity data were obtained from the hospital registry. We employed a widely used measure of the injury severity for each child, the *Injury Severity Score* (ISS, Bolorunduro et al. 2011; Genarelli & Wodzin, 2006), with higher scores indicating greater injury severity. The number of days the child spent in hospital was also included as a measure of injury severity. ISS and days in hospital were significantly positively correlated, $r(71) = .42$, $p < .001$.

Child acute stress. The *Children's Revised Impact of Events Scale* (CRIES-13; Children and War Foundation, 2005; Perrin, Meiser-Stedman & Smith, 2005) is a reliable and valid 13 item self-report measure of *DSM-IV* traumatic stress symptoms (Intrusion, Avoidance and Arousal) completed by children aged 8 and over. The scale is scored on a

four-point scale ("not at all" = 0, "rarely" = 1, "sometimes" = 3, "often" = 5) and items were summed to yield a single total score.

Parent-child interactions. The *Electronically Activated Recorder* (EAR; Mehl, 2017; Mehl et al., 2012; Mehl et al., 2001) is an app that records audio information automatically, and imperceptibly, at regular intervals. The EAR has been shown to be a reliable and valid tool for exploring the social environment (Mehl et al., 2012) and participants typically habituate to its presence in around two hours (Mehl & Holleran, 2007). In our study, the child wore a belt with an iPod Touch enclosed with the EAR app running, over a two-day period of recording at home, as close to discharge as possible. The audio recordings were taken for 30 seconds every 5 minutes between the hours of 07:00 and 22:00. Each family yielded an average of 328 snippets, or 2.73 hours of recordings.

These audio files were transcribed verbatim and behaviorally coded by two independent coders according to who the child was speaking with, their current activity, topic and emotional tone of voice. The double-coding process was implemented to increase reliability. Participant diaries were taken into account during the coding process, particularly when determining the identity of the speaker. For example, if the diary reported that the mother was taking care of the child on the morning of the first day, then the dominant adult female voice was coded as the mother.

In our study, "mother/father interaction time" referred to the percentage of snippets in which the mother/father was present with or actively engaged with the child. Overall, the number of snippets of parent interactions per family ranged from 0 to 189 for mothers (M = 61.21, SD = 44.42, median = 55.68) and 0 to 118 for fathers (M = 28.95, SD = 32.04, median = 14.98). For the parent interaction snippets, "mother/father tone" was also coded on a seven-point scale, ranging from "very negative" to "very positive" with higher scores indicating more positive emotional tone. Emotional tone was conceptualized as the emotional

interpretation of the combination of tone of voice and content of speech, signifying the emotional "feeling" of the conversation. For example, a sarcastic comment may include positive words and tone of voice, but would be coded as a more negative tone, due to the negative meaning of the comment.

In our study, inter-coder reliabilities (one-way random intraclass correlations; ICCs) were adequate for interaction time ($ICC_{Mother\ interaction} = 0.90$, $ICC_{Father\ interaction} = 0.96$) and emotional tone ($ICC_{Mother\ tone} = 0.94$, $ICC_{Father\ tone} = 0.96$) variables. The transcription and coding process is described in more detail in Alisic et al. (2017).

Parent acute stress. The *Acute Stress Disorder Scale* (ASDS; Bryant, 1999; Bryant, Moulds & Guthrie, 2000) is a reliable and valid self-report measure of *DSM-IV* Acute Stress Disorder (ASD) symptoms (including Dissociation, Re-experiencing, Avoidance, and Arousal subscales). Mothers and fathers rated the 19 items on a 5-point Likert scale ("1 = not at all", "5 = very much"), with higher scores indicating greater symptom severity.

Parent optimism. The *Life Orientation Test- Revised* **(**LOT-R; Glaesmer et al., 2012; Scheier, Carver & Bridges, 1994) is a reliable and valid measure of dispositional optimism completed by mothers and fathers. Ten items were rated on a 5-point scale (in our study "1 = disagree a lot", "5 = agree a lot" to stay consistent with the administration of the ASDS, but scored from 0 - 4). Four items were fillers only. The total score is the sum of items 1, 4, and 10 and reverse-scored items 3, 7, and 9, with higher total scores reflecting greater optimism.

Parent self-efficacy. The *Screener for the Development of a Response Post-trauma* SDRP (Cirilli, 2012) was adapted for our study as a 15-item measure of parental self-efficacy (i.e. items that referred to "sick/injured child" were revised to "injured child", responses were rated on a seven- instead of four-point scale). Items were summed to yield a continuous total score, with higher scores indicating greater self-efficacy. Thirty of the families included in our study were recruited prior to this questionnaire being included in the study.

Overall, parental acute stress scores were significantly negatively associated with both optimism, $r(91) = -.20$, $p = .028$ and self-efficacy, $r(69) = -.35$, $p = .002$. Optimism and self-efficacy scores were significantly positively correlated, $r(66) = .47$, $p < .001$.

Procedure

After providing written informed consent, initially one parent (most commonly mothers) was requested to complete the ASDS, and LOT-R, and after a change in protocol, both parents were asked to complete these measures as well as the SDRP. After discharge from the hospital, children wore the EAR for a two-day period at home, usually a weekend. The recordings occurred up to month post-injury, varying due to length of admission and availability of families. Children aged over 8 completed the CRIES-13. The EAR recordings were downloaded, transcribed verbatim and coded by two independent coders.

Analyses. Multilevel modelling was conducted using STATA 15. Otherwise, all statistical analyses were conducted using IBM SPSS version 24, with an alpha level of .05 for

all statistical tests. For the purposes of interpretation, however, we have chosen to focus on effect sizes (Sullivan & Feinn, 2012). The only normally distributed variables were mother interaction time, child acute stress (CRIES-13 scores), optimism (LOT-R scores) for both parents, and father's self-efficacy (SDRP scores). Emotional tone ratings were converted to a percentage of the maximum possible score, ranging from 0% to 100% (Cohen, Cohen, Aiken, & West, 1999) to facilitate interpretation. This did not affect the non-normal distribution of emotional tone ratings.

Given the normality violations, we used non-parametric Spearman's correlations and Friedman tests (Hills, 2011, p. 110, 235) and presented the median as a measure of central tendency. Non-parametric Friedman tests were conducted to test differences in mean ranks of acute stress, optimism, self-efficacy, interaction time and emotional tone for mothers and fathers. Mixed-model analyses of variance (ANOVAs; parent gender x child gender) were conducted on parent interaction time and emotional tone. The ANOVAs were robust to normality and homogeneity of variance assumption violations (Hills, 2011, p. 118). We also used partial correlations and chi-squared analyses where appropriate.

Spearman's correlations explored associations between parent acute stress, optimism, self-efficacy, interaction time and emotional tone. We evaluated statistical independence of mother and father data and found non-independence for only parent optimism, ICC = .21, $F(25, 26) = 1.54$ ($\alpha = .1$, critical value = 1.50) and emotional tone, ICC = .50, $F(52, 53) = 3.01$ ($\alpha = .1$, critical value ranged 1.20-1.38; Grawitch, & Munz, 2004; Kenny, Mannetti, Pierro, Livi, & Kashy, 2002). Given the non-independence of these variables, we presented Spearman's correlations for mothers and fathers separately, as well as for all parents. We also checked for associations with child age, gender, injury severity and length of hospitalization (days).

Multilevel modelling was conducted to acknowledge the nested nature of the data (see Figure 1; Peugh, 2010). However, it did not account for the lack of normality in the data, or residuals (Peugh, 2010).We restructured the data so that each snippet for each parent was on a separate line. That is, we used raw values of parent interaction time (binary, 0 = no interaction, 1 = interaction present) to conduct a logistic multilevel model and emotional tone (continuous) for a normal multilevel model, thus taking into account both within-family and within-parent correlations for each outcome variable.

[insert Figure 1 here]

Regarding the fixed effects, the predictors at level 2 (parent level) included parent gender, acute stress, and optimism. We used grand mean centering for parent acute stress and optimism variables (Peugh, 2010). We opted to remove self-efficacy from this analysis as it did not appear to have a relationship with either of the outcome variables, and substantially reduced the number of parents with complete data. With the exclusion of SDRP scores, we had an adequate number of parents (n = 88 for the emotional tone model, n = 91 for the interaction time model) for inclusion in the multi-level models, within a total of 65 clusters (i.e. families; McNeish & Stapleton, 2016).

We also included level 3 predictors of child age, gender and ISS. We did not include the child's number of days in hospital as it was strongly correlated with ISS, but not with interaction time or emotional tone. To further meet our second aim, we included interactions between parent gender and each of our variables of interest (acute stress and optimism). The random effects included the random intercepts for each level, as well as a random slope to adjust for the effect of time (snippet number).

Results

Child Demographics, Injury Severity and Acute Stress

The 71 included children (n = 42 male, 59.15%) ranged in age from 3 to 16 years (M = 10.41 years, SD = 3.60 years). For the children in our sample, the median number of days in hospital was 2 days (range = 1 to 17 days) and the median injury severity score was 5 (range = 1 to 34; ranging mild to profound according to Bolorunduro et al., 2011). Eligible children (> 8 years old, n = 48) had a median CRIES-13 score of 25.50 (range = 0 to 50) and 19 children (39.58% of eligible children) scored above the cutoff point of 30 for probable Posttraumatic Stress Disorder (Perrin et al., 2005). Although children under 8 could not be included as they were too young to complete the questionnaire, there was a small negative correlation between CRIES-13 scores and child age, $r(48) = -.27$, $p = .034$, such that older children reported fewer traumatic stress symptoms. Child traumatic stress was not significantly correlated with child gender, $r(48) = .01$, $p = .467$ (dummy coded male = 0, female = 1), injury severity, $r(48) = .05$, $p = .371$, or days in hospital, $r(48) = .11$, $p = .231$.

Parent Gender Differences

Table 1 presents medians and ranges for total scores of parent acute stress, optimism, and self-efficacy, as well as interaction time (as a percentage of time spent awake) and emotional tone (presented as a percentage of the maximum possible score) for mothers, fathers, and both parents together.

[insert Table 1 here]

For parent interaction time, there was a statistically significant Chi-square value of 25.8, p <.001, indicating differences between mothers and fathers in time spent interacting with their child; mothers interacting more with their children than fathers. There were no significant differences between mothers and fathers for acute stress, $\chi^2 = .36$, $p = .549$,

optimism, $\chi^2 = .36$, $p = .549$, self-efficacy, $\chi^2 = .14$, $p = .705$, or emotional tone, $\chi^2 = 2.28$, $p = .131$.

Using combined cutoff scores of ≥ 9 on the Dissociation subscale and ≥ 28 on the sum of the other subscales (Bryant et al., 2000), 23 (35.94% of respondents) mothers and 6 (19.35% of respondents) fathers were classified with probable Acute Stress Disorder. There was no relationship between parent gender and classification of the disorder, according to a chi-square test, $\chi^2(1, N = 95) = 2.71$, $p = .153$. Child traumatic stress was significantly positively correlated with mother acute stress, $r(44) = .37$, $p = .007$ but not father acute stress, $r(21) = .04$, $p = .426$, and these findings persisted when child age or gender was controlled. Mother and father acute stress were not significantly correlated, $r(28) = .21$, $p = .145$.

For two-parent families only, we conducted mixed-model ANOVAs (parent gender x child gender) on parent interaction time and emotional tone. For interaction time, there was a significant interaction between parent and child gender, $F(1, 59) = 10.57$, $p = .002$, $\eta_p^2 = .15$. Simple effects analyses revealed that mothers spent more time with their daughters (M = 27.78% wake time, SD = 15.44%) than sons (M = 18.79%, SD = 10.39%), $F(1, 59) = 7.35$, $p = .009$. However, there were no significant differences in proportion of time fathers spent with sons (M = 12.43%, SD = 11.42%) or daughters (M = 8.82%, SD = 8.05%), $F(1, 59) = 1.71$, $p = .196$. On the whole, both daughters, $F(1, 59) = 37.49$, $p < .001$, and sons, $F(1, 59) = 7.50$, $p = .008$, spent more time with mothers than fathers.

For parent emotional tone, there was no significant interaction between parent and child gender, $F(1, 51) = 3.87$, $p = .055$, $\eta_p^2 = .07$. The main effects for parent gender on parent emotional tone, $F(1, 51) = 2.22$, $p = .142$, $\eta_p^2 = .04$, and child gender on parent emotional tone, $F(1, 51) = 3.44$, $p = .070$, $\eta_p^2 = .06$, were also non-significant.

Associations with Parent-Child Interaction Time and Emotional Tone

[insert Figure 2 here]

Figure 2 shows average parent interaction time and emotional tone across the two days of recording for mothers and fathers. Table 2 shows a correlation matrix for all parents, including parent gender (coded 0 = father, 1 = mother), acute stress, optimism, self-efficacy, interaction time, emotional tone, as well as child age, gender, ISS and number of days in hospital. Considering that the optimism and emotional tone variables were non-independent, we present correlations separately for mothers and fathers in Table 3.

[insert Tables 2 & 3 here]

Interaction time. There was a medium to large coefficient for the relationship between parent gender and interaction time, with mothers interacting more with their children than fathers. There was also a medium sized correlation between interaction time and child age, such that parents (and mothers and fathers separately) spent less time with children as they increased in age. Interaction time and parent gender were still significantly positively related when child age was controlled, $r = .44$, $p < .001$. For mothers only, there was a medium-sized relationship between optimism and interaction time, with more optimistic mothers spending more time with their children. Apart from this, interaction time was not significantly associated with parent acute stress, optimism or self-efficacy, or child gender. Overall, and especially for mothers, as parent-child interaction time increased, parental emotional tone of voice became more positive.

Emotional tone. Consistent with the idea that optimism surfaces in interactions in a positive outlook, parents who were more optimistic also spoke to their children in a more positive tone. This medium-sized correlation held for mothers, and approached significance for fathers ($p = .055$). Parent emotional tone was not significantly associated with parent acute stress, self-efficacy, parent gender or child age, overall and for mothers and fathers

separately. There was a small overall relationship between child gender and parent emotional tone, and this correlation was medium-sized for mothers, but non-significant for fathers, such that mothers used a more negative tone of voice with their daughters. Parent emotional tone and optimism were still significantly positively related when child gender was controlled, $r = .28$, $p = .009$.

Injury severity, days in hospital and other relationships. There was one large relationship between father (but not mother) acute stress and days in hospital, where fathers were more stressed the longer their child was in hospital. Fathers of daughters reported more acute stress symptoms than fathers of sons. However, this relationship with child gender was not found for mothers. Conversely, there was a small to medium relationship between mother (but not father) acute stress and injury severity, where mothers were more stressed the greater their child's injury severity. Injury severity and days in hospital were not significantly associated with parent self-efficacy or emotional tone. Particularly for mothers, as days in hospital and injury severity increased, maternal (but not paternal) optimism decreased. Maternal (but not paternal) optimism also decreased with child age. There was also a small to medium negative relationship between injury severity and parent-child interaction time for both mothers and fathers, such that parents spent less time with more severely injured children. For mothers only, interaction time also decreased with more time in hospital.

Multilevel Models

Two multilevel models (see Table 4) were conducted to predict either parent interaction time (logistic) or emotional tone (normal) from parent gender, acute stress and optimism, and child age, gender and ISS. We also checked for interactions between parent gender and our variables of interest (acute stress and optimism). Intra-class correlations revealed that the family accounted for 10.60% of the variance of interaction time and 12.34%

of the variance of emotional tone. Within-parent factors accounted for an additional 14.59% of the variance of interaction time and 0.96% of the variance of emotional tone.

[insert Table 4 here]

As seen in Table 4, child age and parent gender were significant predictors of interaction time, with mothers interacting more with children than fathers, and the probability of parent interactions being lower for older children. None of the predictors were significantly associated with emotional tone.

Discussion

The present study explored parent-child interactions in the context of serious pediatric injury and related parental distress, using an ecological momentary assessment tool, the EAR. More specifically, this study aimed to explore relationships between parent acute stress, optimism and self-efficacy with interaction time and emotional tone. For these variables, we also explored parent gender differences and associations with child demographics and objective injury characteristics.

The findings supported the hypothesis that mothers spend more time interacting with their child post-injury compared to fathers. This is consistent with past parent reports of time spent together (Australian Institute of Family Studies, 2009; Milkie et al., 2015) and may reflect a general difference in time with each parent that persists within the child injury context. This may also explain the significant relationship between child and mother acute stress, but not father acute stress, as mothers may have a greater opportunity to be affected by their child's condition and influence their child's wellbeing, and may also be more burdened with caregiver duties which potentially heighten stress (Holt et al., 2017; Milkie et al., 2015).

In keeping with developmental norms (Åman-Back, & Björkqvist, 2004), parents spent less time with children as they grew older, however the difference in interaction time between mothers and fathers persisted regardless of child age. Mothers also spent more time with daughters than sons, although the direction of this relationship is difficult to determine. It may be that mothers spend more time with daughters, or that daughters seek out more interaction time with mothers. It may also explain mothers' more negative tone of voice with daughters, as mothers have a greater opportunity for conflict to arise with daughters, with more time spent together.

Contrary to our expectations, we did not find a relationship between parent gender and acute stress. This contrasts research on gender differences in traumatic stress symptoms in adults (Tolin & Foa, 2006), as well as studies that have found mothers to be more distressed post-trauma compared to fathers (e.g. Holt et al., 2017). It reinforces that child injury and hospitalization can take a toll on both parents, as both mothers and fathers reported clinical levels of acute stress. However, it is also possible that a higher powered analysis may have identified a gender difference in acute stress, especially as there were unequal numbers of mothers and fathers, and mother and father acute stress were not related.

Mothers and fathers also reported similar levels of optimism and self-efficacy, and did not differ significantly in emotional tone. Our hypotheses regarding behavioral markers of parental stress, optimism and self-efficacy were partially supported. However, findings must be interpreted with caution as the multilevel model was conducted using non-normal data (Peugh, 2010) and correlations did not account for nesting. Spearman's correlations showed a significant relationship between emotional tone and optimism for mothers, such that more optimistic mothers used a more positive tone, or vice versa. For mothers only, optimism was also positively related to interaction time, such that more optimistic mothers spent more time with their children. Put another way, more optimistic mothers were likely to display this in

the way they spoke. As these findings did not persist within the multilevel model, relationships between parent gender, optimism and interaction characteristics warrant further attention in larger samples.

Contrary to our hypotheses, amount and emotional tone of parent-child interactions were not significantly associated with parental acute stress or self-efficacy. That is, parents who were more stressed or higher in self-efficacy did not exhibit this in how much time they spent with their child or their emotional tone. Our findings may suggest that acute stress and self-efficacy are shown more subtly in behavior and mannerisms, rather than more overt interactions. Optimism as a construct may also be more amenable to translation into an objectively measurable interaction characteristic. It may also be that optimism, as a stable personality trait (Dougall et al., 2001), was easier to detect compared to more fluctuating stress and self-efficacy levels that may not have produced a consistent pattern or may have been better evidenced by specific rather than overall interaction characteristics. We also looked at dispositional optimism, rather than specific optimistic beliefs about the injury itself (as in Baker et al., 2005).

Furthermore, greater injury severity and more days in hospital were associated with higher parent stress and lower maternal optimism, but were not associated with parent self-efficacy or emotional tone. While children both in past research (Alisic et al., 2011) and our sample tend to report traumatic stress symptoms regardless of the objective injury severity, parents appeared to be affected by the objective severity of their child's condition. This research lends further support to the notion that pediatric hospitalization itself can be stressful for parents and reduce their hope for the future (Commodari, 2010). Child demographics also may have influenced these relationships as fathers of daughters were more stressed than fathers of sons, and mothers' optimism decreased with child age.

The naturalistic nature of the data enabled consideration of naturally unfolding processes within the home environment, however, there are several limitations of the present study. It is possible that the sampled interactions were an indication of more stable patterns rather than directly influenced by the injury and we did not have any pre-injury data for comparison. However, the injury context may also have provided more time at home, with more care required. The self-report measures and recordings in our study were taken close together. As past research suggests socialization takes place over time, post-trauma (e.g. Bauer et al., 2005), it is possible that effects of parent behavior on child stress might be seen over the months following the event (Wise & Delahanty, 2017).

Another limitation is that over half of fathers did not return questionnaires. This rate is also in line with many past studies with parents (see included papers in a meta-analysis by Morris et al., 2012), indicating that fathers generally are less likely to participate in research studies compared to mothers. In our dataset, this was partially explained by fathers being less involved in their child's care, as we found that fathers who did not participate in questionnaires also spent significantly less time with their child than those who did. The completion rate was also due to a change in protocol whereby initially data was only required from one parent and this was most commonly the mother.

Nevertheless, looking at the quantity of interactions may be simplistic and we need to move towards considering the quality of interactions, which was hinted at by the emotional tone variable. Future studies could examine interactions at a level of micro-dynamics across time, something which was beyond the scope of this paper. In addition, time spent with parents may not unidirectionally be influenced by the parent but also by the child; the child may also bring their own needs, wants and behavior which may affect time spent together and even parental emotional tone of voice. We also compared mothers and fathers from the same

family, meaning parents' time spent with child, and emotional tone may be influenced by their shared circumstance (e.g. employment, designation of parent roles, etc.).

In conclusion, this study showed that mothers spent more time with their child post-injury compared to fathers, but that regardless of gender, parents may experience distress following their child's injury. While fathers are generally underrepresented in surveys and structured observational studies, fathers participated in greater numbers using the EAR. This correlational study cannot draw causal conclusions, however the results ought to encourage further exploration of the role of optimism, as well as differences between mothers and fathers in how they interact with their children after a serious injury.

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Figures

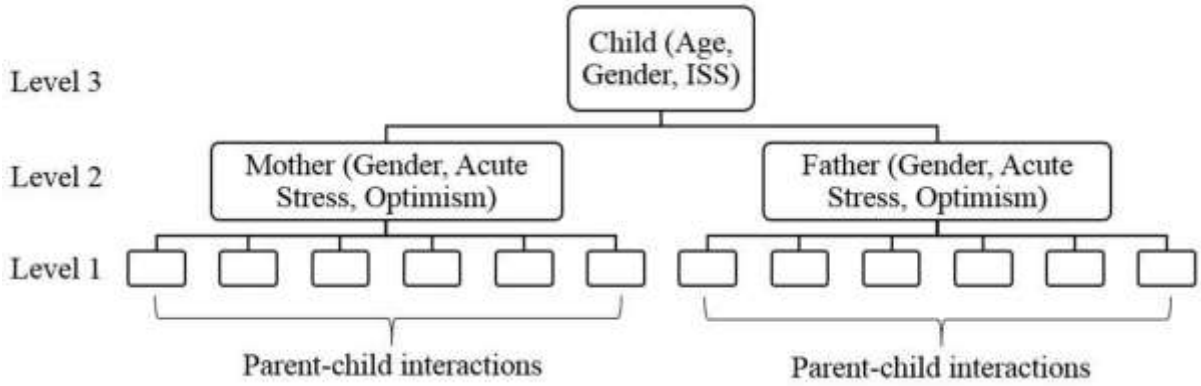

Figure 1. Nested data structure of the multilevel models. Note. Parent-child interactions include the binary presence/absence of interaction and emotional tone ratings for each snippet.

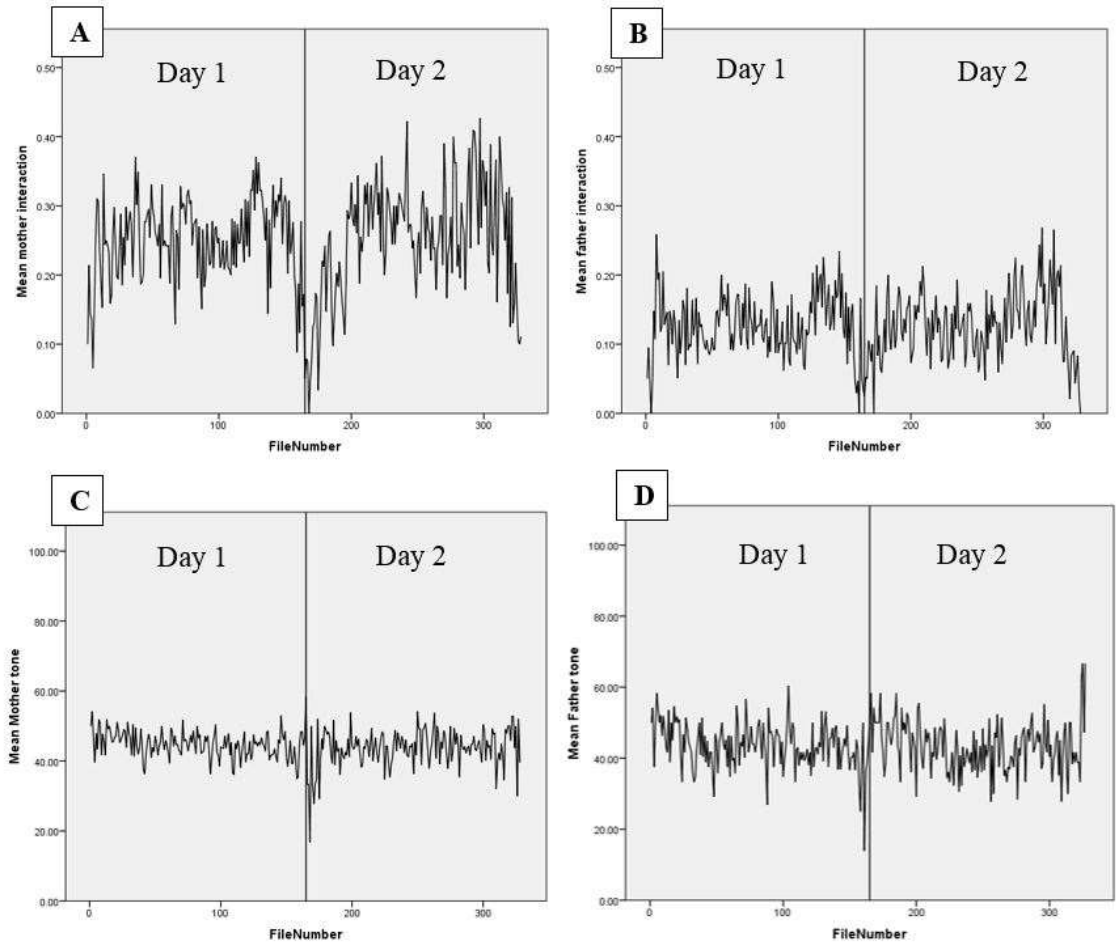

Figure 2. Percentage of mother (A) and father (B) interactions and average emotional tone for mothers (C) and fathers (D) across the two days of recording. Median line notes distinction between Days 1 and 2.

Tables

Table 1

Average Parent Acute Stress, Coping and Interaction Characteristics

Median (Min – Max)	Parents	Mothers	Fathers
Acute stress (ASDS)[a]	33.00 (19 – 81)	35.00 (19 – 81)	31.00 (19 – 61)
Optimism (LOT-R)[b]	17.00 (3 – 24)	16.50 (4 – 24)	18.00 (3 – 24)
Self-efficacy (SDRP)[c]	86.00 (34 – 105)	89.00 (34 – 101)	84.50 (54 – 105)
Interaction time with child (% wake time)	14.16 (0 – 58)	18.92 (0 – 58)	9.01 (0 – 36)
Emotional Tone (% maximum possible score)	46.67 (20.00-57.00)	46.75 (20.00-57.00)	45.61 (24.00-55.00)

Note. *N* varied from 30 to 69, depending on the number of questionnaires available. [a]ASDS = Acute Stress Disorder Scale, [b]LOT-R = Life Orientation Test-Revised, [c]SDRP = Screener for the Development of a Response Post-trauma.

Table 2

Spearman's Correlations for Parent Stress, Coping and Interaction Characteristics

		Parents				
		Acute stress	Optimism	Self-efficacy	Interaction time	Emotional tone
Parents	Interaction time	-.02	.16	-.10	-	
	Emotional tone	-.06	.27**	.20	.26**	-
	Parent gender[a]	.14	-.05	.05	.42***	.07
Children	Age	.10	-.16	.14	-.33***	.02
	Gender[a]	.13	-.06	-.00	.03	-.16*
	Days in hospital	.19*	-.25**	.08	-.10	-.08
	ISS	.26**	-.19*	-.07	-.15*	.07

Note. ***$p < .001$, **$p < .01$, *$p < .05$, N varied from 65 to 95 depending on the number of questionnaires available. [a]Gender was coded 0 = male, 1 = female.

Table 3

Spearman's Correlations for Mother and Father Stress, Coping and Interaction Characteristics

		Mothers					Fathers				
		Acute stress	Optimism	Self-efficacy	Int. time	Emo. tone	Acute stress	Optimism	Self-efficacy	Int. time	Emo. tone
Mothers	Int. time[a]	-.05	.33**	-.23	—						
	Emo. tone[b]	-.10	.26*	.14	.26*	—					
Fathers	Int. time						-.01	-.16	-.04	—	
	Emo. tone						-.01	.31	.29	.19	—
Children	Age	.04	-.28*	.22	-.38**	.05	.15	.08	.01	-.35**	-.02
	Gender[c]	.04	-.13	-.10	.17	-.32**	.34*	.11	.10	-.18	.03
	Days in hospital	.08	-.36**	.07	-.20*	-.11	.50**	-.06	.07	-.16	-.03
	ISS	.24*	-.25*	-.05	-.31**	-.06	.27	-.04	-.09	-.21*	.21

Note. ***$p < .001$, **$p < .01$, *$p < .05$, *N* varied from 27 to 71 depending on the number of questionnaires available. [a]Int. time = interaction time. [b]Emo. tone = emotional tone. [c]Gender was coded 0 = male, 1 = female.

Table 4

Associations Between Predictors and Interaction Characteristics

	Interaction time		Emotional tone	
	β (*SE*)	*p*	β (*SE*)	*p*
Fixed Effects				
Intercept	-.32 (.44)	.470	**3.61 (.15)**	**< .001**
Level 3 predictors (Child)				
Age	**-.17 (.04)**	**< .001**	.00 (.01)	.791
Child gender[a]	.15 (.27)	.577	.02 (.10)	.833
ISS	.02 (.02)	.411	.01 (.01)	.401
Level 2 predictors (Parent)				
Acute stress (centered)	-.00 (.02)	.935	.00 (.01)	.724
Optimism (centered)	-.06 (.04)	.144	-.01 (.01)	.441
Parent gender[a]	**.69 (.23)**	**.003**	.02 (.06)	.808
Within-level interactions				
Parent gender x acute stress (centered)	.01 (.02)	.799	-.00 (.01)	.455
Parent gender x optimism (centred)	.08 (.05)	.071	.01 (.01)	.228
Random Effects		[95% CI[b]]		[95% CI]
Intercept variance[c]	-	-	**.73 (.01)**	**[.71, .76]**
Intercept variance (level 3)	**.47 (.22)**	**[.18, 1.19]**	**.10 (.03)**	**[.06, .17]**
Intercept variance (level 2)	**.64 (.21)**	**[.34, 1.22]**	**.01 (.01)**	**[.00, .09]**
Random slope variance (level 2)	.00 (.00)	[.00, .00]	.00 (.00)	[.00, .00]

Note. Significant effects are in bold text. [a]Gender was coded 0 = male, 1 = female. [b]CI = confidence interval. [c]The level 1 intercept variance for interaction time was defined as $\pi^2/3$ (StataCorp, 2017).