A Measurement and Prospective Study of Co-Rumination in Parent-Adolescent Conversations Several Years After a Devastating Tornado

By

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A Measurement and Prospective Study of Co-Rumination in Parent-Adolescent Conversations

Several Years After a Devastating Tornado

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Abstract

Parent-child communication plays an important role in children's disaster recovery. However, when conversations include co-rumination, defined as extensively rehashing and dwelling on problems with others, there may be both risks and benefits for psychological adjustment. In the current study, 200 adolescents (ages 13 to 17 years; 64% male; 80% African American) and their parents who experienced an EF-4 tornado in April 2011 provided joint recollections about their tornado experiences approximately 5 years post-tornado. Youth were drawn from an ongoing prevention study for aggressive behaviors. The first aim was to determine if the four components of co-rumination (rehashing problems, dwelling on negative affect, mutual encouragement of problem talk, and speculating about problems) could be identified, and reliably measured, in the parent-adolescent tornado conversations. The second aim was to examine the prospective associations between two early youth-level risk factors—youth posttraumatic stress symptoms (PTSS) and resting respiratory sinus arrhythmia (RSA)— measured within the first year after the tornado and co-rumination several years later. Results indicated that the four components of co-rumination could be identified and reliably measured and loaded onto a single latent factor. In addition, youth PTSS was associated with "dwelling on negative affect" only at low levels of resting RSA (an index of physiological dysregulation) and after considering variance associated with the other three co-rumination components. There was no association between youth PTSS and "dwelling on negative affect" when youth were physiologically regulated. PTSS and resting RSA were unrelated to the other three co-rumination components. Overall, results provide preliminary evidence establishing the co-rumination coding scheme in a sample of disaster-exposed parents and adolescents. Results also indicated that PTSS and resting RSA are important youth-level factors that relate to the long-term quality of parent-child talk about their disaster experiences 5 years post exposure. *Keywords:* co-rumination, natural disasters, posttraumatic stress, respiratory sinus arrhythmia, parent-child communication

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Each year, over 100 million children are exposed to natural disasters (United Nations Office for Disaster Risk Reduction, 2019) and these disasters can have variable, and long-lasting, psychological impacts on youth and families. Many youth demonstrate elevated mental health concerns within the first few months and years following disaster exposure (Bonanno et al., 2010). Yet there is extensive variability in children's responses to natural disasters, with some youth presenting with chronic symptoms over time, others who get better, and still others who never develop mental health symptoms at all (Lai et al., 2017). Youth mental health response to disaster exposure is influenced by many factors including individual-, family-, and community-related factors (Bonanno et al., 2010). With regards to the family, greater parent support has been associated with fewer internalizing symptoms and posttraumatic stress symptoms (PTSS) even years after exposure (Felix et al., 2013; McDonald et al., 2019) whereas greater parental distress has been linked to sustained youth PTSS (Bonanno et al., 2010). Given the importance of the family environment for youth post-disaster adjustment, the current study focuses specifically on qualities of parent-child communication about their disaster experiences.

Parents and children often discuss past difficult experiences together (Vernberg et al., 2016) and parent-child talk about past experiences influences the ways in which youth learn to self-regulate and cope with negative emotion (Bögels & Brechman-Toussaint, 2006; Miller-Slough & Dunsmore, 2016). A small, but growing, body of research has assessed parent-child co-reminiscing specifically about trauma experiences and how these communication patterns influence youth posttraumatic adjustment. Sales and Fivush (2005) found that youth had fewer internalizing and externalizing symptoms when mothers both acknowledged negative emotions *and* provided solutions while co-reminiscing about stressful experiences related to their children's asthma. Moreover, it has been proposed that parents who respond to their youth's emotion expression by focusing on their own distress, or magnifying their youth's worries, may prolong and exacerbate their adolescents' mental health symptoms (Moed et al., 2015; O'Neal & Magai, 2005). Thus, extensive focus on negative emotional experiences while co-reminiscing about stressful events may be linked to poor posttraumatic adjustment in children.

Despite the importance of co-reminiscing for children's posttraumatic adjustment, relatively few studies have examined parent-child co-reminiscing about natural disasters. In the extant literature, parent egocentrism (Hendrickson et al., 2020) and parent over-focus on negative emotion (Abel et al., 2020) when discussing shared disaster experiences were associated with long-term PTSS and anxiety symptoms in tornado-exposed adolescents. Another study of school-aged youth exposed to an EF5 tornado in Joplin, Missouri found that high maternal validation and acknowledgment of children's emotion talk was associated with low levels of youth PTSS approximately one year after the tornado (Abel et al., 2021). Thus, it appears that some forms of emotional guidance and engagement from parents in the aftermath of a disaster can help children process their emotions and adapt following the event (Bonanno et al., 2010; Vernberg et al., 2016). The current study extends this work and examines a particular quality of co-reminiscing—called *co-rumination*—while parents and adolescents jointly recalled their experiences during and after the 2011 Tuscaloosa-Birmingham Tornado.

The aims of the current study are twofold: (1) to measure co-rumination during conversations about a shared tornado experience; and (2) to explore two youth-level factors—youth PTSS and resting respiratory sinus arrythmia (RSA; an index of emotion regulation)—that may increase the likelihood of engaging in co-rumination several years after the tornado. Understanding factors that may influence the quality of parent-child communication is important to inform recommendations for how to talk with youth about shared trauma (i.e., trauma experienced by both parents and children). Of note, youth in the proposed study were identified as having clinically significant aggressive behaviors prior to the tornado. It is possible that youth with this existing behavioral vulnerability, in combination with emotion regulation difficulties, may have more difficulty coping with their disaster experiences, making this a particularly important group to study.

Defining the Construct of Co-Rumination

Co-rumination is a dyadic process characterized by rehashing problems, dwelling on negative affect, speculating about problems, and mutual encouragement of problem talk (Rose, 2002; Rose et al., 2014). Rehashing refers to discussing details of problems repeatedly, dwelling on negative affect refers to discussing how the problem makes the person feel, speculating refers to discussing possible outcomes, origins, or consequences of problems, and mutual encouragement refers to attempts to keep the conversation going (Rose, 2002). For example, consider two friends who talk to each other all day at school about perceived peer rejection and then continue the conversation at night by phone. In this situation, the friends may rehash the details of the event, prompt problem talk from each other, and speculate about what “could have happened”. Ultimately, these conversations may increase perceived relational closeness (Schwartz-Mette & Rose, 2012). However, extensive focus on problems without discussing solutions may not always be beneficial psychologically.

Conceptually, co-rumination is marked by a combination of self-disclosure and rumination (Rose, 2002). Theories of self-disclosure (e.g., Buhrmester & Prager, 1995) suggest that disclosure engenders social benefits, including eliciting perceived emotional closeness (Camarena, Sarigiani, & Peterson, 1990). Within the friendship literature, disclosure of private thoughts and feelings has generally been linked to positive quality friendships and feelings of companionship, relational authenticity, and emotional closeness (e.g., Camarena et al., 1990; Parker & Asher, 1993). Co-rumination may reflect an extreme form of self-disclosure that involves sharing thoughts and feelings in a manner that is repetitive, speculative, and overly focused on negative emotions and experiences. In a study of peer friendships, only co-rumination, not normative self-disclosure, mediated the association between problem talk and high internalizing symptoms (Schwartz-Mette & Rose, 2012).

In addition, co-rumination is an associated, but distinct, construct from rumination (Rose, 2002). Rumination is defined as independently or privately dwelling on negative emotions and problems and has been linked to higher levels of depressive symptoms among youth (e.g., Hart & Thompson, 1997). Similar to rumination, co-rumination involves repeated focus on negative affect and cognitions. However, rumination is an individual, cognitive process, whereas co-rumination is a dyadic, social process that may involve reinforcement or encouragement from a partner. Much like rumination, co-rumination is hypothesized to be linked to internalizing symptoms because of the excessive, pervasive focus on negative experiences both concurrently (Calmes & Roberts, 2008; Rose, 2002; Rose et al., 2007; Starr & Davila, 2009) and longitudinally (Hankin et al., 2007; Rose et al., 2007). Further, co-rumination has been associated with *fewer* internalizing symptoms when controlling for rumination, suggesting that the link between co-rumination and internalizing symptoms may be due to shared variance with rumination (Rose, 2002). Thus, co-rumination is associated with adjustment trade-offs: co-rumination is linked both to perceived relational closeness (Calmes & Roberts, 2008; Rose, 2002; Rose et al., 2007) and internalizing symptoms (Rose, 2002; Rose et al., 2007; Starr & Davila, 2009).

Co-Rumination and Psychological Outcomes

There are several pathways through which co-rumination might relate to youth mental health symptoms. One of these pathways is referred to as "empathetic distress" in which conversation partners may take on each other's distress during problem talk, in turn becoming distressed themselves (Smith & Rose, 2011). Another pathway is that youth may become distressed during problem talk if their conversation partner offers negative or no solutions. In fact, co-ruminating youth tend to perceive problems as being more serious and difficult to solve (Rose et al., 2017). This view is also consistent with findings that individual rumination is associated with problems seeming unsolvable (Lyubomirsky & Nolen-Hoeksema, 1995). Finally, only one of the four elements of co-rumination—dwelling on negative affect—appears to be associated with internalizing problems whereas the other elements of co-rumination are not (e.g., Byrd-Craven et al., 2008, 2011; Davidson et al., 2014; Rose et al., 2014). Indeed, extensive focus on negative emotion during problem talk is conceptually most similar to rumination, a core component of depression (Nolen-Hoeksema, 2000).

Co-rumination also appears to have a reciprocal relation with internalizing symptoms (Rose et al., 2007; Hankin et al., 2010). First, co-rumination is related to anxiety and depression symptoms longitudinally (Rose et al., 2007). Perseverative focus on problems and negative experiences may also cause those problems to feel more significant, ultimately contributing to more worry about those problems over time. Second, internalizing symptoms appear to increase the likelihood of later co-rumination (e.g., Rose et al., 2007); youth with anxiety and depressive symptoms may be more likely to notice negative aspects of their environment or perceive challenges as threatening. Thus, there may be a bidirectional, and longitudinal, link between co-rumination and psychological adjustment. However, more longitudinal research is needed to clarify the direction of these effects over longer periods of time. The current study looks at whether early symptoms predict greater co-rumination later in time.

Co-Rumination with Parents

Much of the literature on co-rumination pertains to friendship dyads. There is limited information regarding how co-rumination operates within parent-child dyads. In one of the few studies that has examined co-rumination with a parent, more frequent self-reported co-rumination was associated concurrently with higher levels of youth depressive and anxiety symptoms (Waller & Rose, 2010). Another study found that undergraduate students reported engaging in co-rumination with their parents (Calmes & Roberts, 2008), suggesting that co-rumination with parents occurs even among young adult offspring. A recent study examined self-reported co-rumination between parents and children (ages 10-19 years) following exposure to severe floods in Texas (Felix et al., 2020). For both parents and children, severity of flood exposure was associated with higher levels of depression and anxiety at high levels of self-reported co-rumination. However, to date, no studies have examined parent-child co-rumination in conversations and no studies have examined factors that may contribute to later parent-child co-rumination.

Adolescence is a particularly critical period to study co-rumination because parents tend to discuss problems more frequently with older youth due to their developmental level and ability to engage in complex conversations (Waller & Rose, 2010). Further, co-rumination may interfere with adolescents' autonomy development—a key developmental task for adolescents—and lead to boundary problems, oversharing, or enmeshment (Olson, 2000), ultimately contributing to worse functioning over time. Given that co-rumination appears relevant for adolescent adjustment in friendships, understanding how co-rumination operates across a range of adolescent relationships is warranted.

Gender Differences in Co-Rumination

Co-rumination appears to operate differently for boys and girls, particularly within the parent-child relationship. Mothers tend to engage in more frequent co-rumination with their daughters compared to sons, especially during adolescence (Waller & Rose, 2010). One possibility is that parents are more likely to discuss negative emotions with girls compared to boys (e.g., Fivush et al., 2000; Klimes-Dougan et al., 2007; Reese et al., 1993). The higher frequency of emotion-based conversations with girls compared to boys may increase the likelihood that girls are more comfortable discussing their emotions, particularly negative ones. In fact, girls have been found to use more emotion terms in conversations compared to boys (O'Kearney & Dadds, 2004). Boys are also more likely to be socialized to inhibit negative emotions of sadness and fear (Garside & Klimes-Dougan, 2002).

Measuring Co-Rumination

Most studies of co-rumination have relied on self-report questionnaires. Only five known studies have used observational methods to assess co-rumination in conversations (Borowski & Zeman, 2018; Byrd-Craven et al, 2008, 2011; Rankin et al., 2018; Rose et al., 2014) and all of these studies examined friendship dyads. The current study uses an observational assessment of co-rumination to measure more precisely conversational style and ways that dyads elicit and reinforce problem talk. Observational assessment allows for an examination of dyadic processes that may be difficult to capture through self-report measures. Guided by the definition of co-rumination (Rose, 2002), and previous observational work in friendships (e.g., Rose et al., 2014), this author developed a coding scheme to assess co-rumination in parent-adolescent conversations. Parent-adolescent dyads were given scores for each of the four proposed components of co-rumination: (a) rehashing problems; (b) speculating about problems; (c) mutual encouragement of problem talk; and (d) dwelling on negative affect. This is the first attempt to replicate this work in parent-adolescent dyads.

Survey and observational studies have found that the four components of co-rumination—as defined theoretically by Rose (2002)—load onto a single latent factor (Rose, 2002; Rose et al., 2014). As such, most studies of co-rumination have collapsed the four components into a total global score. However, examining the elements of co-rumination separately may help to explain why co-rumination is linked to both psychopathology and high relational quality. In fact, the components are differentially related to internalizing symptoms and relational quality, suggesting that the components are related, but distinct constructs. For example, in an observational study, Rose and colleagues (2014) found that only dwelling on negative affect was uniquely associated with internalizing symptoms after controlling for the other components. The other elements (i.e., rehashing, speculating, and mutual encouragement) were only associated with positive friendship quality. That is, co-ruminating partners who responded with engaged responses, including validation, asking questions, and sharing a related experience, reported higher relational closeness and fewer internalizing symptoms (Rose et al., 2014). Other observational studies have found that only dwelling on negative affect was uniquely associated with physiological arousal following a stress task after controlling for variance accounted for by the other components (Byrd et al., 2008, 2011). The components, as assessed by the co-rumination questionnaire, are also correlated with observational measures of co-rumination components (Davidson et al., 2014), suggesting good convergent validity. Overall, it appears that internalizing symptoms may be related to only some aspects of co-rumination, particularly when the co-rumination conversations are characterized by extensive focus on negative emotion. However, this the first study to evaluate if this pattern is found in parent-adolescent relationships.

Co-Rumination about Trauma Experiences

Co-rumination may be particularly important to understand when co-reminiscing about traumatic experiences because certain patterns of co-reminiscing may exacerbate youth PTSS. For example, both centering conversations around parents' own distress and over-focus on negative experiences have been shown to increase risk for youth PTSS (e.g., Abel et al., 2020; Hendrickson et al., 2020; Katz et al., 2012). Parent validation of youth's emotion expression also moderated the link between exposure to intimate partner violence and youth internalizing symptoms (Katz & Windecker-Nelson, 2006). Thus, certain styles of co-reminiscing may relate to youth posttraumatic adjustment. However, no research has examined the association between co-rumination and PTSS and only one study has assessed self-reported co-rumination in the context of shared trauma like natural disasters (Felix et al., 2020). Natural disasters provide a unique context in which to examine parent-child co-rumination because they are a form of shared trauma in which all individuals are exposed and potentially managing ongoing distress. In fact, higher levels of parent distress were associated with greater mental health concerns in children following disaster exposure (Bonanno et al., 2010). Seeking support from a co-survivor of a natural disaster is also associated with post-disaster mental health problems (Hoyt et al., 2010). Thus, the quality of parent-child communication about shared disaster experiences warrants further evaluation. The current study aims to address this gap in the literature.

Co-Rumination and Physiological Dysregulation

Given the mixed associations between co-rumination and youth adjustment, examining early predictors of co-rumination about trauma is an important next step to understand who may be most likely to engage in co-rumination. However, it has been challenging to identify the youth who are most at risk for long-term post-disaster mental health concerns. In line with an ecological systems perspective (Bronfenbrenner & Morris, 2006; Masten & Obradovic, 2008), children’s responses to natural disasters are influenced by the many systems surrounding them including family (Felix et al., 2013), community (Bonnano et al., 2010), and individual level or biological vulnerabilities (Weems, 2015). A growing area of research has focused on individual biological correlates of risk and resilience that influence youth disaster response (Weems, 2015). One such biological sensitivity is reflected in physiological correlates of the body’s fear system. There is growing evidence that youth internalizing problems are characterized by physiological arousal, evidenced by sympathetic nervous system (SNS) activation coupled with failure of the parasympathetic nervous system (PNS) to apply the vagal brake in response to stress (Weems, 2015).

Parasympathetic Nervous System and Respiratory Sinus Arrhythmia (RSA)

The PNS is the body’s regulatory system, and one such marker of regulation is heart rate variability as assessed by respiratory sinus arrhythmia (RSA; Grossman et al., 1990). Specifically, RSA is the naturally occurring change in heart rate that occurs during the normal breathing cycle (e.g., inhalation and exhalation). High RSA reflects greater variability in the intervals between heart beats for inhalation and exhalation. At rest, high RSA is a measure of the “vagal brake”, promoting physiological homeostasis (Porges, 1991, 2007a). Polyvagal Theory (Porges, 1995, 2007a) states that the myelinated ventral vagus nerve has an inhibitory influence on the heart and can quickly calm an individual. According to this theory, high RSA *at rest* prepares the individual for adaptation should a change in condition occur (e.g., Beauchaine, 2001; Butler et al., 1992). In response to a stressor, individuals will automatically orient and disengage the "vagal brake", resulting in increases in heart rate, attention, and social skills that may be necessary to reduce threat. In other words, the release of the inhibitory "vagal brake" allows the body to rapidly respond to the environment without activating the SNS (Porges, 2007a). Thus, RSA withdrawal in response to challenge or stress (i.e., going from high RSA at rest to low RSA post-stressor) promotes adaptive functioning and emotion regulation (Porges, 2007a). When the challenge subsides, the "vagal brake" is reactivated, reducing arousal and bringing the body back to a neutral state.

It follows that low RSA *at rest* reflects decreased flexibility or preparedness for stress and has been associated with a range of psychological problems including aggression (Gordis et al., 2010), anxiety (Scott & Weems, 2014), and PTSS (Mikolajewski & Scheeringa, 2018). In fact, low resting RSA has been described as a measure of emotion dysregulation and over-reactivity among children (Beauchaine, 2001). For example, youth with anxiety disorders demonstrate lower resting RSA compared to non-anxious youth (Sharma et al., 2011). Other studies have found an association between lower resting RSA and higher anxiety symptoms (e.g., El-Sheikh et al., 2011; Scott & Weems, 2014).

The Link Between Resting RSA and Trauma Exposure

As noted, certain profiles of physiological functioning may increase risk for psychopathology following exposure to trauma (Belsky & Pluess, 2009; Weems, 2015). However, most of this literature has focused on child maltreatment or relational stressors as opposed to non-interpersonal traumas (e.g., natural disasters). For example, one study found that child maltreatment was associated with more aggressive behaviors for boys with lower levels of resting RSA compared to higher levels (Gordis et al., 2009). Katz and Gurtovenko (2015) found an interaction between youth resting RSA and maternal PTSS among youth exposed to intimate partner violence, such that maternal PTSS was associated with higher youth PTSS only at lower levels of resting RSA. Yet another study found that the link between peer victimization and social anxiety was stronger among youth with lower resting RSA assessed during an experimental peer rejection activity (Gazelle & Druhen, 2009). Further, exposure to one or more childhood adversities (e.g., abuse, poverty, neighborhood violence) was related to elevated internalizing symptoms for adolescents with lower, but not higher, resting RSA (McLaughlin et al., 2014). Overall, resting RSA appears to be associated with response to single-episode and relational traumas.

Only three published studies have explored youth's physiological functioning in the context of disasters. Pfefferbaum and colleagues (2011) found that children exposed to the Oklahoma City bombing demonstrated faster heart rate and higher systolic blood pressure when asked to describe their experiences during the bombing compared to a non-exposed control group. Another study examined youth exposed to at least one hurricane (e.g., Hurricane Katrina, Hurricane Rita, Hurricane Gustav, or Hurricane Isaac) and found that lower resting RSA was associated with higher anxiety symptoms (Scott & Weems, 2014). Mikolajewski and Sheeringa (2018) found that lower resting RSA and suppressed RSA withdrawal significantly predicted post-disaster PTSS. These studies provide preliminary support that, for some individuals, reactions to natural disasters may be marked by problems with the parasympathetic regulatory system, such as a failure of the PNS to "apply a brake". Taken together, these findings suggest that low resting RSA may be one particularly important biomarker of stress sensitivity that predicts maladaptive disaster response among youth.

In regards to co-rumination, two extant studies have found that co-rumination relates to greater physiological dysregulation in response to stress, marked by elevated cortisol and increased hypothalamic-pituitary-adrenal axis activity following a stress task (Byrd-Craven et al., 2008, 2011). These links were particularly strong when co-rumination was focused on the discussion of negative emotion. However, no studies have examined physiological dysregulation as a prospective predictor of later co-rumination about natural disasters. It is possible that high sensitivity to threat perception, or physiological dysregulation at rest, may foster excessive focus on negative emotional experiences, setting the stage for ruminative patterns of conversation when co-reminiscing over time.

The Tuscaloosa-Birmingham Tornado

Participants in the proposed study were exposed to a series of tornadoes on April 27, 2011 in the cities of Tuscaloosa and Birmingham, Alabama. The largest of these tornadoes was a category EF-4, the second highest severity category on the Enhanced Fujita scale, and produced winds up 190 miles per hour. The widest part of the tornado was 1.5 miles in width and it stayed on the ground for 80 miles. Many individuals living in these communities were exposed to tornado-related traumatic events, including loss of belongings, destruction of property, financial loss, perceived life threat, and persistent emotional distress during, and in the months and years after, the disaster. Overall, the tornado resulted in approximately 1,500 injuries, 65 deaths, and caused significant damage to 2,500 homes. Given the breadth of the destruction, the Tuscaloosa-Birmingham tornado has been classified as one of the deadliest natural disasters in the state of Alabama (National Centers for Environmental Information, 2017).

Aims of the Current Study

Although there is extant literature supporting associations between internalizing symptoms and co-rumination, no research has examined the link between PTSS and co-rumination or examined observed co-rumination in conversations about natural disasters. Further, no research has assessed the components of co-rumination in parent-adolescent dyads using observational methods. Additionally, according to the ecological systems perspective, youth response following disaster exposure depends on an interaction of many factors including biological and emotional vulnerabilities. However, no research has explored physiological markers of PNS functioning that may influence certain styles of co-reminiscing about trauma experiences. The current study aims to fill these gaps in the literature. Addressing these gaps is essential to understanding risk factors that may increase the likelihood of processing disaster-related trauma via co-rumination and to increase understanding of how to help parents and adolescents communicate following disasters. Disaster-related youth PTSS and youth resting RSA will be considered as the two candidate prospective risk factors. The two aims are detailed below.

Aim 1: Measuring Parent-Adolescent Co-Rumination

The first aim of the current study was to measure the construct of co-rumination reliably using an observational task in which parents and adolescents were asked to discuss their experiences during and after the 2011 Tuscaloosa-Birmingham tornado. A coding scheme was adapted by this author from Rose and colleagues' (2014) observational work on co-rumination in peer relationships and modified for a trauma context using knowledge derived from emotion socialization and trauma recollection literature. It was expected that the four co-rumination components (rehashing problems, speculating about problems, mutual encouragement of problems, and dwelling on negative affect) would be present within parent-adolescent conversations about the tornado and could be reliably measured during the tornado conversations. Further, it was hypothesized that the four components would co-occur (based on correlations) in similar patterns observed in previous observational co-rumination research with peers (e.g., Byrd-Craven et al., 2008, 2001; Rose et al., 2014). Finally, consistent with survey research indicating that the items representing these four constructs load onto a single factor, the four observed components were expected to load on to a single latent measurement factor and form an internally reliable co-rumination score.

Aim 2: Examining Prospective Associations Between Youth PTSS, Resting RSA, and Co-Rumination

The second aim of the current study was to evaluate the prospective associations between disaster-related youth PTSS and the four co-rumination components and the potential moderating influence of physiological regulation at rest. Youth physiological regulation at rest was assessed via the PNS marker of resting RSA, with low resting RSA being indicative of physiological dysregulation. The four components of co-rumination were considered simultaneously as outcomes. First, it was hypothesized that youth PTSS measured within the first six months post-tornado would be associated with parent-adolescent co-rumination approximately five years later. Second, youth resting RSA, assessed one year post-tornado, would moderate this association, such that this link would be stronger for youth who showed lower levels of resting RSA compared to higher levels. Third, it was expected that the moderating role of resting RSA on the association between PTSS and co-rumination would emerge for girls, but not for boys. These main effects and interaction paths were only expected to be significant for the component of “dwelling on negative affect” given that this component is conceptually most similar to rumination and most consistently linked to internalizing problems. Because the components of rehashing problems, speculating about problems, and mutual encouragement of problem talk reflect engagement in conversations and an effort to find solutions or resolutions, these components were not expected to be related to youth PTSS or resting RSA. Given that the components were expected to relate differentially to youth PTSS and resting RSA, the four components were examined simultaneously in all models rather than using the latent co-rumination factor. However, it was also expected that the interaction of PTSS and resting RSA would relate to "dwelling on negative affect" even after considering variance shared with the latent factor.

Method

Recruitment and Participants

This project builds on an ongoing, prospective study examining youth social and emotional functioning pre and post a devastating category EF-4 tornado. Youth were initially recruited into a preventive intervention for aggressive behaviors in their 4th grade year (see Lochman et al., 2015). Youth were recruited from 20 elementary schools in urban and rural Alabama during three consecutive academic school years (between 2009 and 2011). In order to meet eligibility for study participation, youth had to screen at-risk on a teacher-report measure of aggression (Proactive-Reactive Aggression Questionnaire; Dodge & Coie, 1987). All children who scored at or above the 25th percentile were contacted and invited to participate in the program. Parents then completed a parent-report measure of aggression (Behavioral Assessment System for Children, Aggression Subscale; Reynolds & Kamphaus, 1992). All children whose parent-report of aggression was in the elevated range were eligible for inclusion in the Coping Power intervention program. A total of 6 children from each of the 20 elementary schools were included in the program (n=120 per cohort) for a total of 360 children across the three cohorts. The Coping Power intervention program was delivered during the second semester of fourth grade and both semesters of fifth grade. More details about the intervention procedures can be found in Lochman et al. (2015).

Due to research constraints (e.g., inability to locate participants who had moved, inability to schedule assessments within given time periods), recollections about the tornado were only collected from 277 parent-adolescent dyads (77% of the original sample). Of those 277 dyads, 67 were excluded due to interviewer deviation from the standardized protocol and 10 were excluded because they had a male parent, resulting in a final sample of 200 youth. See Figure 1 for a description of inclusion criteria and attrition rates.

Chi-square tests and t-tests were conducted to compare race/ethnicity, gender, and income of the 200 participants used in the current sample to individuals who participated in the recollection data collection but whose data were not included in analyses (N = 77). Youth were comparable in terms of gender (χ^2 = .15, p = .70), race/ethnicity (χ^2 = 8.31, p = .22), family income (t = .83, p = .41), age at tornado (t = 1.71, p = .09), severity of tornado exposure (TORTE; t = .25, p = .81), and PTSS at Wave 2 (t = 1.30, p = .19). Table 1 presents full characteristics for the study sample. For the 200 families included in the proposed study, youth were between the ages of 13 and 18 years old (M_{age} = 15.53) when the tornado interviews were conducted, were 64% male (n=128), and 80% African American (n=160). The sample was also predominantly low income with 33% of families making less than $30,000 per year.

Figure 1

Model of Participant Inclusion Criteria

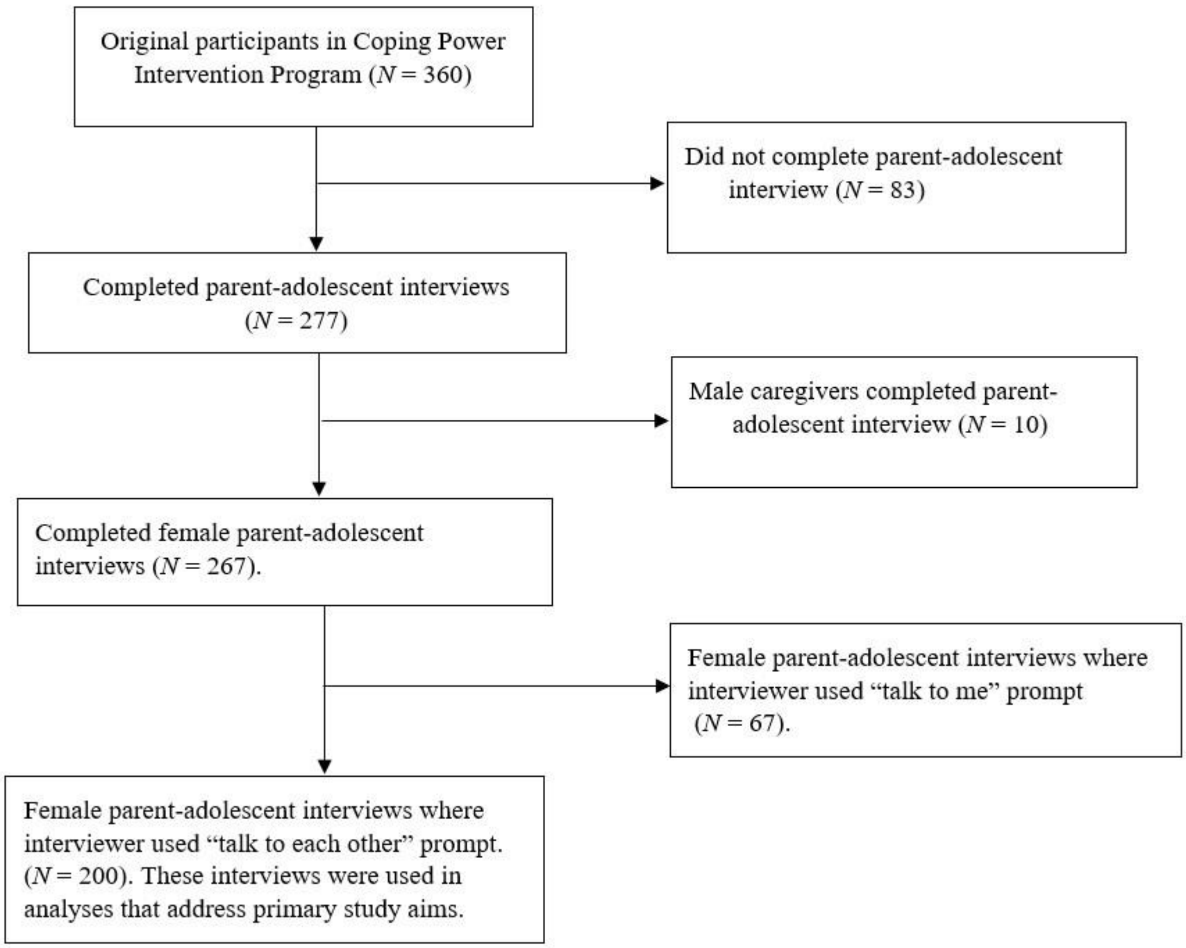


Table 1

Demographic Characteristics of Sample

Variable	Full sample (n = 200)
Youth age at tornado interviews (M, SD)	15.53 (1.27)
Youth Gender (% male)	64.00% (128)
Youth Race/Ethnicity	
African American	80.00% (160)
White	17.00% (34)
Biracial	2.00 % (4)
Other/Unknown	1.00% (2)
Annual Family Income	
No Income	5.00% (10)
<$10,000	12.00% (24)
$10,000-$19,999	21.00% (42)
$20,000-$29,999	25.50% (51)
$30,000-$39,999	13.00% (26)
$40,000-$59,999	13.00% (26)
$60,000-$74,999	6.00% (12)
>$75,000	4.50% (9)
Parent Marital Status	
Married	33.50% (67)
Single	41.00% (82)
Divorced	15.50% (31)
Separated	6.00% (12)
Widowed	1.00% (2)
Co-Habitating	3.00 (6)

Procedures

Data were collected in six waves as part of the larger, longitudinal study. In the current study, data from Waves 2-6 were included. However, all Waves are described below in order to give context for the larger project. Wave 1 data were collected prior to the tornado; Wave 2 data were collected within the first 6 months following the tornado; Wave 3 data were collected approximately 1 year post-tornado; and Waves 4-6 data were collected approximately 3, 4, and 5 years post-tornado, respectively.

Parent and adolescent dyads completed a series of assessments at each wave of data collection as part of the larger longitudinal study on the effects of the tornado on a sample of youth with elevated levels of aggressive behaviors. Not all measures collected were used in the current project. Assessments relevant to the current study are described below. First, a self-report measure of youth disaster-related PTSS was collected at Wave 2, within the first 6 months following the tornado. Second, all youth participated in the Iowa Gambling Task, a decision-making task, at Wave 3 (approximately 1 year post-tornado). RSA data were collected continuously during baseline (i.e., pre-task) and task participation, however only RSA pre-task data (i.e., resting RSA) was used in this study. Third, parent-adolescent joint recollections were collected at either Wave 4, 5, or 6 depending on research staff availability to conduct the interviews. At each wave, parents received $50 and youth received $10 for study participation. More detailed information about each of these assessments is provided in the Measures section.

Assessments were completed at the family residence or in a research office according to participant preference. Parents and adolescents first met individually with a research staff to complete assessment measures. Then parents and adolescents met together to complete a co-reminiscing task in which they were asked to speak to each other about their experiences during and after the tornado. Recollections were conducted by trained research assistants and were audiotaped.

Measures

Tornado Recollections

Trained research assistants completed the recollections by reading a series of five standardized open-ended prompts. Although the research assistants remained in the room during the recollections, they were instructed not to speak except to give the prompts. Additionally, the research assistants were instructed to emphasize that the parent-adolescent joint recollection task was meant for parents and adolescents to "talk to each other" and to physically turn away from participants during the task. Participants were allowed to speak about each prompt for as long as they wanted before receiving the next prompt. Joint recollections lasted 230 seconds (3.80 minutes) on average. Similar prompts have been used in other studies examining recollections of natural disasters (e.g., Bauer et al., 2007; Hambrick et al., 2018). The prompts were as follows:

1. Talk with each other about some of the things that happened to you or your family because of the tornado.
2. Talk with each other about some challenging or difficult things that happened to you or your family because of the tornado.
3. Talk with each other about what positive things, if any, happened to you or your family because of the tornado.
4. Talk with each other about how, compared to your life before the tornado, things are different for you or your family now.
5. Is there anything else you would like to tell each other about the tornado?

During Wave 4, interviewers occasionally deviated from the interview script and made comments throughout the interview. As a result, many of the Wave 4 interviews contained unstandardized, and thus un-codable, segments. For this reason, 75% of the Wave 4 interviews were excluded and then re-collected at either Wave 5 or 6 following a retraining for research staff. During this retraining, research staff were provided with a more detailed study protocol and script. Research staff were also instructed to emphasize that the joint interviews were intended to be a conversation between the parent and adolescent, rather than talking to the interviewer directly. In conclusion, 9% of interviews were collected at Wave 4, 62% of interviews were collected at Wave 5, and 29% were collected at Wave 6. Given that the age of the adolescents varied across the waves of data collection, wave was controlled for in all analyses.

Co-rumination coding. The co-rumination coding scheme was adapted by this author from previous observational research that captured co-rumination in friendship dyads (see Rose et al., 2014). Interviews were transcribed verbatim and were coded for the four co-rumination components of dwelling on negative affect, rehashing problems, mutual encouragement of problem talk, and speculating about problems. Transcripts were coded for each of these components one at a time. During coding, coders read through the verbatim transcript and listened to the entire interview before coding. They also were allowed to listen to the audio and read the transcriptions as many times as needed throughout coding. All transcripts were double coded by a research assistant and this author for reliability. Coding discrepancies were discussed among coders until arriving at consensus.

Initially, each parent-adolescent dyad was rated on a 5-point Likert scale for each of the four co-rumination components: (a) dwelling on negative affect; (b) mutual encouragement of problem talk (e.g., encouraged each other to keep talking about problems); (c) rehashing problems (e.g., repeatedly discussed the same problem); and (d) speculating about problems (e.g., estimated possible outcomes, causes, or consequences). Dyads were rated according to the degree to which they engage in each of the dimensions from *not at all/very little* (1) to *very much*

(5). Following initial analyses for Aim 1 (see Results section), an additional category of 0 was added to the coding scheme. Dyads were given a score of 0 if they did not speak during the entire interview or stated that “nothing happened” or there was “no effect”. Adding this coding category resulted in a 6-point Likert scale for each of the co-rumination components from *not at all* (0) to *very much* (5). Both the 5-point and 6-point scoring were included in analyses for Aim 1 and were compared psychometrically. Only the 6-point scoring was used in analyses for Aim 2. The full coding scheme for co-rumination is provided in Appendix A.

Resting Respiratory Sinus Arrhythmia (RSA)

Resting RSA was used as an index of emotion regulation. At Wave 3, heart rate and inter-beat intervals, both collected to determine resting RSA, were measured continuously using a portable physiological data recorder (BioLog). Electrodes were placed above the right collarbone, behind the left knee, and on the right side of the neck. Youth first watched a 3-minute neutral video depicting Hawaiian scenery to measure baseline arousal. This is an empirically supported method to assess baseline levels of arousal (Piferi et al., 2000). The video is intended to be neutral and unlikely to elicit an emotional reaction and also provides an opportunity for the participant to become acclimated to the equipment. Resting RSA was calculated based on the final 60 seconds of the video to allow for time for the adolescent to become acclimated.

RSA data was analyzed using the CardioEdit and CardioBatch computer software and procedures outlined by Porges’ manual for inter-beat-interval editing (2007b). Heartbeats and cardiac interbeat intervals are extracted and edited by hand to remove unwanted artifacts. Unwanted artifacts include errors or outliers in data due to the digitizing process or unintentional participant movement. Outliers or errors were identified by comparing data points to surrounding data points, as well as patterns overall in the data. Per guidelines recommended by Porges

(2007b), outliers were edited by averaging, combining, or dividing the data points, rather than deleting them. Of note, if more than 5% of the data points required editing, these participants were removed from the sample (i.e., no RSA calculated). To calculate RSA, a predominant rhythm was first identified from the participant's heart period and was determined to be the RSA start point. Data was collected 10 times per second and averages were calculated to determine resting RSA.

Post-Traumatic Stress Symptoms

Youth post-traumatic stress symptoms were assessed using the PTSD-Reaction Index (PTSD-RI), an 18-item self-report questionnaire (Frederick et al., 1992). Youth completed this measure at Wave 2 within the first 6 months after the tornado. Youth responded to all questions in relation to their experiences during and after the tornado. For ease of administration to children, and according to an adaptation by La Greca and colleagues (1996), the original 5-point Likert scale was reduced to a 3-point Likert scale (none of the time, some of the time, most of the time). The items were scored 0, 2, 4, respectively, so as to match the original scale scoring. Items were summed to create a total scale score and higher scores indicate greater symptom severity. Notably, there is no established clinical cut off using the revised scoring, although some studies have drawn a clinical level line at 40 points (e.g., La Greca et al., 2013). The PTSD-RI has demonstrated good sensitivity when compared with clinically confirmed cases of PTSD (Pynoos et al., 1993). The measure has been used previously in studies of natural disasters, including hurricanes (e.g., La Greca et al., 2013), earthquakes (Goenjian et al., 2005), bushfires (Yelland et al., 2010), and tornados (e.g., Hendrickson et al., 2020) and has demonstrated good internal consistency ranging from .83 to .90 (Anthony et al., 2005; Vernberg et al., 1996). In the current study, the alpha coefficient for the total score was .90.

Tornado Exposure

Severity of tornado exposure was assessed using the child self-report version of the Tornado-Related Traumatic Experiences questionnaire (TORTE; Vernberg & Jacobs, 2005). Youth completed this measure at Wave 3 within the first year after the tornado. The TORTE is adapted from the Hurricane-Related Traumatic Experiences (HURTE) questionnaire, a measure originally created to assess hurricane exposure and distress following Hurricane Andrew in 1992 (Vernberg et al., 1996). The exposure score is the sum of the 6 categorical (yes/no) items of events experienced during the tornado (e.g., windows or doors broke, saw someone get hurt), 1 categorical (yes/no) item of perceived life threat ("at any time, did you think you might die during the tornado"), and 10 categorical (yes/no) items assessing traumatic events, loss, and disruption in the months following exposure (e.g., home damaged or destroyed, had to move, had to switch schools). A total score is computed by summing these 17 items, with higher scores reflecting greater severity of exposure. Severity of exposure was used as a covariate in all analyses given that exposure severity is consistently associated with greater youth mental health concerns following disaster exposure (e.g., Bonanno et al., 2010).

Power Analysis

Monte Carlo simulation (Muthén & Muthén, 2002) in Mplus v8.2 was used to determine power for multiple regression with interaction effects within a path analysis framework for a sample size of 200. This type of power analysis uses simulations to generate data from a population model and test power for each individual coefficient. The model is tested in multiple random samples, called replications. According to standards for sufficient power recommended by Muthén and Muthén (2002), power was estimated at the .80 level. All variables were set to be standardized with means = 0 and standard deviations = 1. Effect sizes were estimated according to Cohen's correlation values for small (.1), medium (.3), and large (.5) effects. First, the 95% cover shows the proportions of replications to explain whether the parameters and their standard errors are suitably assessed. Coverage should remain between .91 and .98 (Muthén & Muthén, 2002). In the current simulation, values were estimated above .94 for large (0.5) and medium (0.3) effects and above .93 for small effects (0.1). Second, the percent of significant coefficients indicates the percentage of replications for which the null hypothesis—that a parameter is equal to zero—is correctly rejected at the .05 level. When a large (0.5), medium (0.3), and small (0.1) effect size was simulated, the power of each coefficient was estimated at over .99 for large and medium effects and over .31 for small effects. Thus, values for large and medium effects are above the standard power of 0.8, suggesting sufficient power to detect medium to large effects with a sample size of 200. Previous studies using similar path models (e.g., Becker et al., 2014; Fite et al., 2014) had sample sizes ranging from 142 to 173 and have been able to detect moderate to large effects.

Data Analysis Plan

Aim 1: Measuring Parent-Adolescent Co-Rumination

Inter-rater reliability for each co-rumination variable was conducted using SPSS Version 27. Intra-class correlations (ICC) were generated for the four components of co-rumination. ICCs for co-rumination were calculated using a two-way mixed effects model for ICC coefficients. Descriptive statistics were also be generated in order to examine the distribution and frequency of the variables. Data were also screened for violations of normality. Zero-order correlations (or point-biserial correlations, where indicated) among the co-rumination variables, other primary study variables (e.g., PTSS, resting RSA), and demographics (e.g., gender, age) were calculated to examine relations among the variables.

Psychometric assessment for the extent to which a single latent trait could predict a pattern of association among 4 items was conducted using Item Factor Analysis (IFA) in Mplus v8.2 (Muthén & Muthén, 1998-2018). These models use a cumulative link function (i.e., logit or probit) and a conditional multinominal response distribution, in which the category outcomes are predicted using binary submodels (0 vs 12345, 01 vs 2345, 012 vs 345, 0123 vs 45, and 01234 vs 5). Submodels are computed via loadings and thresholds as follows: Each model has an item-specific loading and category-specific threshold (which becomes an intercept when multiplied by -1). The factor loading is the expected change in the link-transformed response for a one-unit change in the latent trait score. The threshold gives the link-transformed probability of response when theta is 0 (mean of sample). For ease of interpretation, thresholds are converted into difficulty values (their analogous Item Response Theory parameter), which give the theta value (latent trait value) at which switching to the next scoring option happens with 50% probability (e.g., the theta value at which switching from 0 to 12345 happens with 50% probability).

Assessment of model fit was conducted via weighted least squares estimator using a mean- and variance-corrected χ^2 (WLSMV). Multiple fit indices were examined to evaluate model fit, including chi-square test of global model fit, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). CFI values range from 0 to 1; values > .90 and > .95 indicate acceptable and good model fit, respectively. RMSEA values between .08 and .05 indicate acceptable model fit and values < .05 reflect good fit (Brown, 2015). Local misfit was diagnosed by examining the specific sources of discrepancy between the model-predicted and data-estimated covariances (as available using the RESIDUAL option in M*plus* v8.2). Finally, the fit of nested models was compared using the DIFFTEST procedure in M*plus* v8.2.

Aim 2: Prospective Associations Among Youth PTSS, Resting RSA, and Co-Rumination

A path model within a structural equation modeling framework was estimated to determine unique, longitudinal associations between PTSS measured 6 months post-tornado and the four co-rumination components assessed approximately 5 years later. The potential moderating effect of resting RSA was then explored. The four components of co-rumination were predicted simultaneously. All outcomes were treated as ordinal variables and thus WLSMV estimation with theta parameterization and a probit link function were used. As such, separate thresholds were estimated for the 5 binary submodels per item (0 vs 12345, 01 vs 2345, 012 vs 345, 0123 vs 45, and 01234 vs 5). The threshold gives the link-transformed probability of response when theta is 0 (mean of sample). For ease of graphing interactions, thresholds are multiplied by -1 to convert to intercepts. The model assumed proportional odds (i.e., the regression slopes predicting each binary submodel are the same) as is common in predicting ordinal outcomes (Hardin & Hilbe, 2018). Consistent with previous research indicating that there are gender differences in co-rumination (e.g., Rose, 2002), this variable was included as a covariate in the analyses. Severity of tornado exposure (TORTE) and wave of interview data collection was also included in all models as covariates. Path models were conducted using Mplus v8.2 statistical software (Muthén & Muthén, 2018).

Skewness of each co-rumination variable was less than three; this is consistent with guidelines for normality in path analysis (Kline, 2016). Accordingly, maximum likelihood estimation was used with all path models. Specifically, full information maximum likelihood estimation (FIMLE) was used to accommodate the missing data in the proposed study. FIMLE estimates a likelihood function for each individual based on the variables present in the model in order to use all available data (Kline, 2016). Further, FIMLE has been found to be less biased and more efficient than other methods (e.g., listwise deletion) that are used to accommodate up to 50% missing data assuming missing at random (Arbuckle, 1996). Participants with missing PTSS data (the exogenous predictor) were included in analyses by estimating the predictor's parameters (mean and variance). This model was considered to be just-identified (zero degrees of freedom), resulting in a perfect fit to the data (Kline, 2016); thus, model fit statistics are not relevant to be reported.

A hierarchical approach was used. A first-order effects model was estimated in which the four components of co-rumination were simultaneously regressed on PTSS, resting RSA, and covariates (gender, wave of data collection, and severity of tornado exposure). Then the interaction term between PTSS and resting RSA was added in order to determine if resting RSA moderated the link between PTSS and each co-rumination component. All continuous independent variables were standardized prior to analyses in order to aid in the interpretation of interaction effects. For significant interactions, simple slopes at high (+1 standard deviation) and low (−1 standard deviation) levels of resting RSA were estimated to determine the nature of the interaction effect (Aiken & West, 1991). Finally, gender differences in the interaction pathways were estimated via a multiple-group path model.

Results

Descriptive Statistics and Correlations

Correlations for main study variables are presented in Table 2. Correlations were generally in expected directions. Each of the four co-rumination constructs were positively and significantly associated with each other (r's = .47 - .73). In addition, high levels of dwelling on negative affect were associated with high levels of youth PTSS (r = .16, $p < .01$). No other co-rumination construct was associated with youth PTSS. Resting RSA was not significantly correlated with any co-rumination component. However, resting RSA was significantly correlated with wave of interview data collection, such that high levels of resting RSA were associated with earlier wave. Severity of tornado exposure (e.g., TORTE) was significantly and positively correlated mutual encouragement, rehashing problems, and speculating about problems (r's = .15 - .22). However, severity of exposure was unrelated to dwelling on negative affect. In addition, girls and boys demonstrated similar levels of dwelling on negative affect (t = .56, p = .57) and speculating about problems (t = 1.11, p = .27); however, boys compared to girls demonstrated higher levels of mutual encouragement of problem talk (t = 2.34, p = .02) and rehashing problems (t = 2.11, p = .04). Girls and boys demonstrated similar levels of resting RSA (t = -.26, p = .81); however, girls demonstrated higher levels of PTSS at Wave 2 than boys (t = -2.45, p = .02). Finally, although many youth self-reported PTSS in the average and high average range, 16% endorsed clinically significant levels of PTSS (score >= 40).

Table 2

Correlations Among Co-Rumination and Primary Study Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Gender	-								
2. TORTE	-.08	-							
3. Wave	-.01	-.23*	-						
4. Dwelling on Neg Affect	-.04	.11	.04	-					
5. Mutual Encouragement	-.16*	.15*	-.003	.65**	-				
6. Speculating about Problems	-.08	.22**	.01	.47**	.73**	-			
7. Rehashing	-.14	.16*	.07	.70**	.67**	.68**	-		
8. Youth PTSS	.17*	.20*	-.14	.16*	.03	.05	.08	-	
9. Resting RSA	.03	.06	-.19*	.02	-.11	-.05	-.11	.08	-
Mean	-	1.53	-	1.60	2.36	2.09	1.79	22.51	7.30
Standard Deviation	-	2.12	-	1.22	1.28	1.31	1.08	15.99	1.22
Minimum	0	0	4	0	0	0	0	0	3.47
Maximum	1	13	6	5	5	5	5	68	9.88

Note: Wave = wave of data collection when tornado recollections were collected; Neg = negative; PTSS = posttraumatic stress symptoms collected at Wave 2; TORTE = severity of tornado exposure total score; resting RSA = resting respiratory sinus arrythmia collected at Wave 3; for gender, boy = 0 and girl = 1
**p* < .05; ***p* <.01

Aim 1: Measuring Parent-Adolescent Co-Rumination

Data analysis for Aim 1 began with examining inter-rater reliability via intra-class correlation (ICC) of the four co-rumination variables. Descriptive statistics were also generated in order to examine the distribution and frequency of the variables. See Table 3 for full results. The ICCs were 0.76 for dwelling on negative affect, 0.84 for mutual encouragement of problem talk, 0.78 for speculating about problems, and 0.78 for rehashing problems. These values are considered to be in the good reliability range according to common standards (e.g., Koo & Li, 2016). Data were screened for violations of normality and all data fell within the recommended guidelines for skewness and kurtosis as recommended by Kline (2016).

Table 3

Descriptives and Inter-Rater Reliability of Co-Rumination Components

Quality	Mean	SD	Range	Skewness	Kurtosis	ICC
Original Coding (1-5 Scale)						
Dwelling on Negative Affect	1.69	1.13	1-5	1.56	1.30	0.76
Mutual Encouragement of Problem Talk	2.46	1.13	1-5	0.45	-0.47	0.84
Speculating About Problems	2.18	1.19	1-5	1.42	1.19	0.78
Rehashing Problems	1.88	0.97	1-5	1.00	0.53	0.78
Modified Coding (0-5 Scale)						
Dwelling on Negative Affect	1.60	1.22	0-5	1.24	0.85	0.76
Mutual Encouragement of Problem Talk	2.36	1.28	0-5	0.02	-0.37	0.84
Speculating About Problems	2.09	1.31	0-5	0.52	-0.24	0.78
Rehashing Problems	1.79	1.08	0-5	0.54	0.15	0.78

Note: ICC = intra-class correlation; ICC run as a two-way mixed effect model with absolute agreement

Item Factor Analysis (IFA) for Original 5-Category Coding

A single-trait model was first fit for the four ordinal items using WLSMV, in which the latent trait mean and variance were fixed for identification to 0 and 1, respectively. These analyses used the original item scoring on an ordinal scale of 1 to 5. Separate factor loadings were estimated for each item, and separate thresholds were estimated for binary submodel per item as described above. This model exhibited acceptable fit by CFI and SRMR, but unacceptable fit by RMSEA and the significant χ^2 test of absolute fit (likely due to sample size) as shown in Table 4. Potential sources of local misfit were identified using the normalized residual covariance matrix, available via the RESIDUAL output option in M*plus*. The normalized residual covariance matrix shows how far off the estimated model is from the data. A relatively large negative residual covariance was observed among “dwelling on negative affect” and “speculating about problems”, indicating that these items were more related than was predicted by the single-factor model.

The necessity of covarying the error terms for these two items was tested by specifying a one-factor model in which “dwelling on negative affect” and “speculating about problems” were allowed to correlate. As reported in Table 4, results of this model revealed an acceptable fit for the four item one-factor model: $\chi^2 = 1.49$, $p = .22$, RMSEA = .05, SRMR = .009, CFI = 1.00. In addition, the one-factor model fit significantly worse than the modified one-factor model, DIFFTEST (1) = 15.65, $p < .001$. Thus, model discrepancies were captured via one additional covariance among two items, resulting in a significant improvement in fit. The revised model with the four items plus the additional error covariance appeared to measure a single construct as initially hypothesized. Further examination of local fit via normalized residual covariances and modification indices yielded no interpretable remaining relationships and thus this modified one-factor model was retained.

Table 4

Factor Analysis Assessment of Model Fit Using WLSMV

Model	# Items	# Free Parameters	Chi-Square Value	Chi-Square DF	Chi-Square p-value	CFI	RMSEA Estimate	RMSEA Lower CI	RMSEA Higher CI	RMSEA p-value	SRMR
Original Item Coding (1 to 5)											
One-Factor	4	20	13.67	2	.001	.99	.17	.09	.26	.007	.03
Modified One-Factor	4	21	1.50	1	.22	1.00	.05	<.001	.20	.33	.009
Modified Item Coding (0 to 5)											
One-Factor	4	24	12.23	2	.002	.996	.16	.08	.25	.013	.02
Modified One-Factor	4	25	1.73	1	.187	1.00	.06	<.001	.21	.29	.006

Note: WLSMV = weighted least square mean and variance adjusted estimators; RMSEA = Root mean square error of approximation; SRMR = Standardized root mean square residual

Model parameters are shown in Table 5, which includes the IFA item parameters (thresholds and loadings), as well as their Item Response Theory (IRT) analogous parameter of item difficulty. The IRT discrimination parameter (defined as the slope at each difficulty value) is the same as the item loading in this case. The net result of these item parameters can be described more succinctly by examining the overall reliability with which the latent trait has been measured. In IFA or IRT models—as in any kind of model with a nonlinear relationship between item response and the latent trait—reliability is trait-specific, most often characterized by a quantity known as *test information.* Test information is the size or strength of the slope at each theta value for each item. For ease of interpretation, the test information function created by the items was converted to a traditional measure of reliability that ranges from 0 to 1 as reliability = information/(information + 1). Figure 2a shows that test reliability is ≥ .80 from about 1.5 SDs below the mean and up, suggesting that the latent factor does a good job of measuring people who scored ≥ −1.5 SD on the latent trait.

Item difficulty (i.e., latent trait value at which probability of the next scoring option is equal to .50) demonstrates that no items are measuring less than 1 SD below the mean (see Figure 3a). This indicates that it may be harder to differentiate those individuals on the low end of the latent trait, especially for “dwelling on negative affect”. However, all items have wide spread of their category thresholds, suggesting that the category options are differentiable. Finally, item discrimination ranged from 1.27 to 2.12 and the item responses are generally well distributed in expected directions across theta values (see Appendix B, Supplemental Figure 1).

Table 5

IFA and IRT Parameters for Original 5-Category Coding (1-5 Scale)

	IFA Parameters		IRT Parameters	
	Loading		Discrimination	
Slope Parameters	Estimate	SE	Estimate	SE
1. Dwelling	1.32	0.20	1.32	0.20
2. Mutual	2.12	0.33	2.12	0.33
3. Rehashing	1.78	0.23	1.78	0.23
4. Speculating	1.27	0.14	1.27	0.14
	Threshold		Difficulty	
Location Parameters: y > 1	Estimate	SE	Estimate	SE
1. Dwelling	0.68	0.17	0.52	0.12
2. Mutual	-1.73	0.30	-0.82	0.11
3. Speculating	-0.60	0.14	-0.47	0.12
4. Rehashing	-0.36	0.18	-0.20	0.10
	Threshold		Difficulty	
Location Parameters: y > 2	Estimate	SE	Estimate	SE
1. Dwelling	1.40	0.20	1.06	0.15
2. Mutual	0.24	0.21	0.11	0.10
3. Speculating	0.73	0.15	0.58	0.12
4. Rehashing	1.51	0.22	0.85	0.12
	Threshold		Difficulty	
Location Parameters: y > 3	Estimate	SE	Estimate	SE
1. Dwelling	2.08	0.24	1.57	0.19
2. Mutual	2.24	0.30	1.06	0.13
3. Speculating	1.71	0.18	1.35	0.17
4. Rehashing	3.01	0.33	1.69	0.18
	Threshold		Difficulty	
Location Parameters: y > 4	Estimate	SE	Estimate	SE
1. Dwelling	3.00	0.36	2.27	0.26
2. Mutual	3.74	0.51	1.77	0.18
3. Speculating	2.45	0.25	1.93	0.21
4. Rehashing	4.43	0.54	2.49	0.29

Note: IFA = Item Factor Analysis; IRT = Item Response Theory; Factor loadings = change in logit (y) per unit change in theta; discriminations = slope at each difficulty value; thresholds = expected logit (y = 0) when theta is 0 (mean of sample); difficulties = theta at which probability of the next option is equal to .50.

Item Factor Analysis (IFA) for Modified 6-Category Coding

To summarize, results with the original 5-point Likert scale scoring indicated that it may be harder to differentiate individuals on the low end of the latent trait. This means that coding for the lower end of the scale may need more scoring options in order to more sensitively assess those with low co-rumination scores. As such, all parent-child dyads who provided minimal to no content in their joint recollections (e.g., "no effect" or "nothing happened") were given a score of 0 for all four co-rumination components. All analyses were re-run with the new co-rumination variables scored on a 6-point Likert scale (0 to 5). These results are reported below.

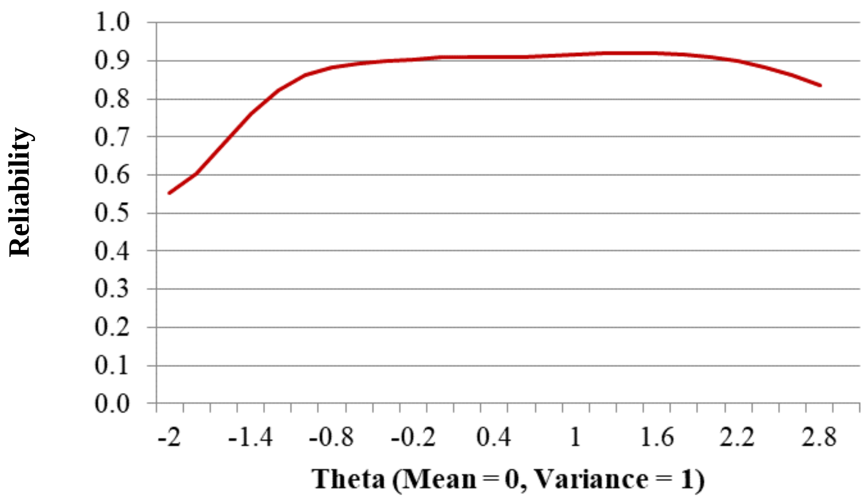
A single-trait model was fit for the four ordinal items using WLSMV, in which the latent trait mean and variance were fixed for identification to 0 and 1, respectively. Separate factor loadings were estimated for each item, and separate thresholds were estimated for binary submodel per item. This model exhibited acceptable fit by CFI and SRMR, but unacceptable fit by RMSEA and the significant χ^2 test of absolute fit as shown in Table 4. Potential sources of local misfit included the relatively large negative residual covariance among "dwelling on negative affect" and "speculating about problems". Thus, a one-factor model in which these items were allowed to correlate was specified. As reported in Table 4, results of this modified model revealed an acceptable fit for the four item one-factor model: $\chi^2 = 1.73$, $p = .19$, RMSEA = .06, SRMR = .006, CFI = 1.00. In addition, the one-factor model fit significantly worse than this modified one-factor model, DIFFTEST (1) = 14.02, $p = .002$. Thus, model discrepancies were captured via one additional covariance among two items, resulting in a significant improvement in fit. There were no other sources of local misfit identified via normalized residual covariances and modification indices. Thus, the four items plus one error covariance appeared to measure a single construct as initially hypothesized and the modified one-factor model was retained.

Model parameters are shown in Table 6, which includes the IFA item parameters (thresholds and loadings), as well as their Item Response Theory (IRT) analogous parameter of item difficulty and discrimination. The net result of these item parameters can be described more succinctly by examining the overall reliability with which the latent trait has been measured. As described above, in IFA or IRT models, reliability is trait-specific and characterized by a quantity known as *test information* (e.g., the size or strength of the slope at each theta value for each item). For ease of interpretation, the test information function created by the items was converted to a traditional measure of reliability that ranges from 0 to 1 as reliability = information/(information + 1). Figure 2b shows that test reliability is ≥ .80 from about 2.5 SDs below the mean and up, suggesting that the latent factor does a good job of measuring people who scored ≥ −2.5 SD on the latent trait.

Item difficulty (see Figure 3b) demonstrates that all items are measuring from 1.5 SDs below the mean to approximately 2 SDs above the mean of the latent trait. This indicates that the measure is able to differentiate individuals on the low, mean, and high level of the latent trait for all items. All items have wide spread of their category thresholds, suggesting that the category options are differentiable. Finally, item discrimination ranged from 1.53 to 2.27 and the item responses are generally well distributed in expected directions across theta values (see Appendix B, Supplemental Figure 2).

Figure 2a

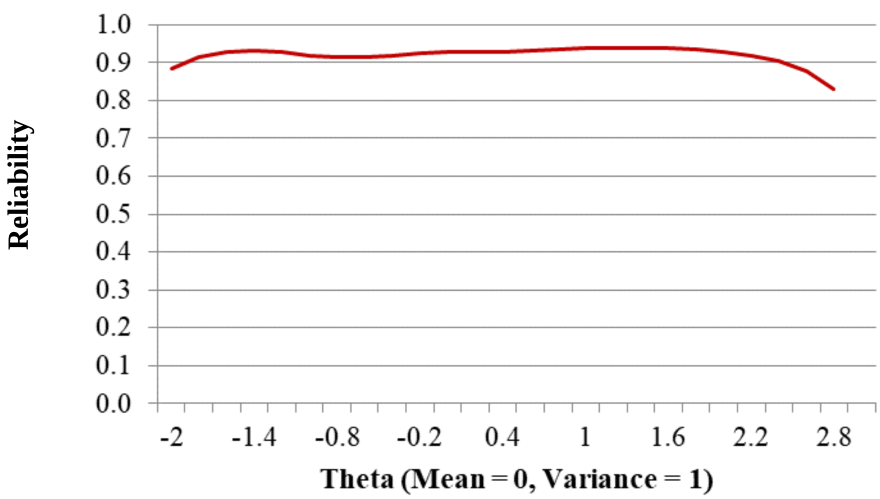
Reliability for Original 5-Point Likert Scale



Note: Reliability is above .80 from about -1.5 standard deviations and up. To measure lower thetas below -1.5 we need more category discrimination.

Figure 2b

Reliability for Modified 6-Point Likert Scale



Note: Reliability is above .80 from about -2.5 standard deviations and up and above .90 from about -1.5 to 2.5 SDs.

Figure 3a

Spread of Item Difficulty for Original 5-Point Likert Scale

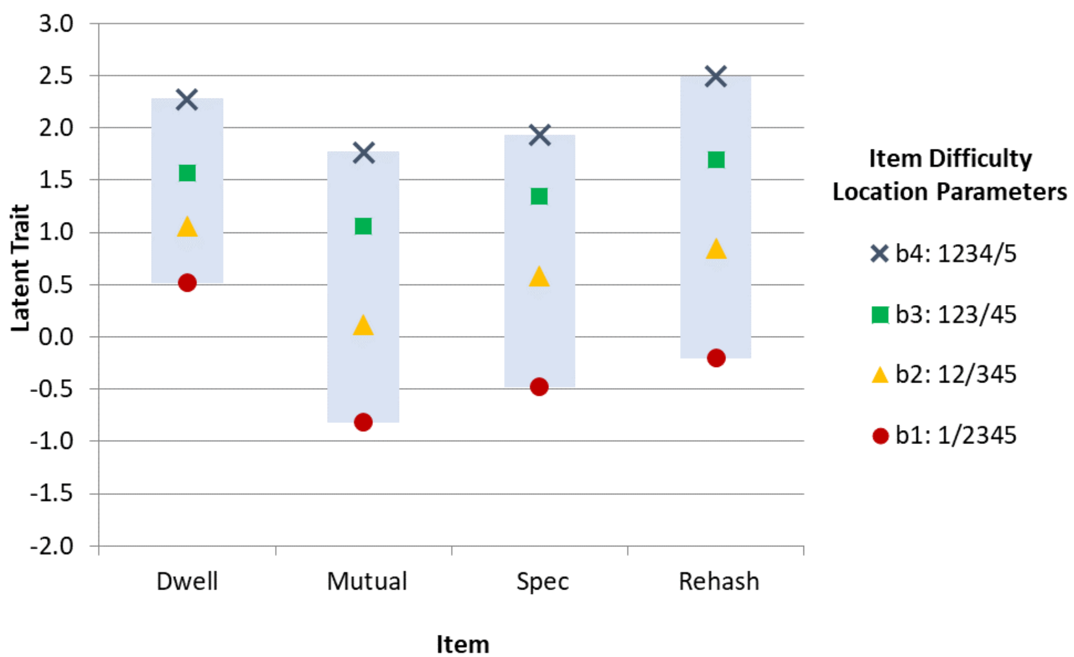


Figure 3b

Spread of Item Difficulty for Modified 6-Point Likert Scale

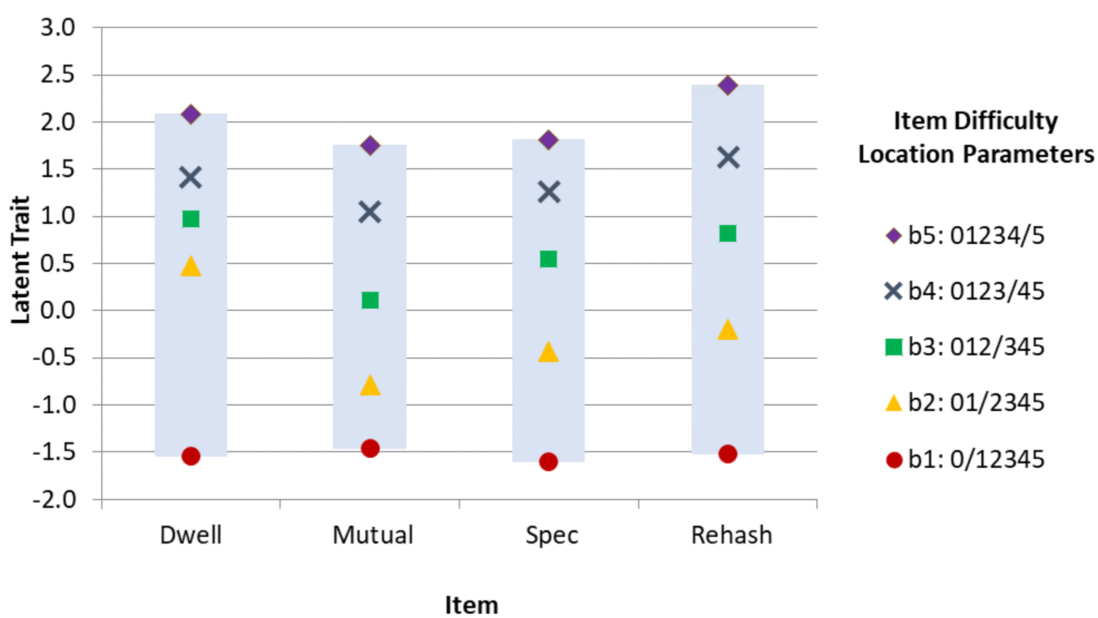


Table 6

IFA and IRT Parameters for Modified 6-Category Coding (0-5 Scale)

	IFA Parameters		IRT Parameters	
	Loading		Discrimination	
Slope Parameters	Estimate	SE	Estimate	SE
1. Dwelling	1.75	0.20	1.75	0.20
2. Mutual	2.27	0.26	2.27	0.26
3. Speculating	1.53	0.15	1.53	0.15
4. Rehashing	2.18	0.25	2.18	0.25
	Threshold		Difficulty	
Location Parameters: y > 0	Estimate	SE	Estimate	SE
1. Dwelling	-2.70	0.33	-1.54	0.15
2. Mutual	-3.32	0.41	-1.47	0.14
3. Speculating	-2.45	0.25	-1.60	0.17
4. Rehashing	-3.22	0.39	-1.48	0.14
	Threshold		Difficulty	
Location Parameters: y > 1	Estimate	SE	Estimate	SE
1. Dwelling	0.831	0.20	0.48	0.11
2. Mutual	-1.79	0.27	-0.79	0.11
3. Speculating	-0.65	0.16	-0.43	0.10
4. Rehashing	-0.42	0.21	-0.19	0.12
	Threshold		Difficulty	
Location Parameters: y > 2	Estimate	SE	Estimate	SE
1. Dwelling	1.70	0.23	0.97	0.12
2. Mutual	0.25	0.22	0.11	0.10
3. Speculating	0.83	0.17	0.54	0.11
4. Rehashing	1.77	0.26	0.81	0.11
	Threshold		Difficulty	
Location Parameters: y > 3	Estimate	SE	Estimate	SE
1. Dwelling	2.47	0.27	1.41	0.15
2. Mutual	2.36	0.27	1.04	0.12
3. Speculating	1.93	0.20	1.27	0.15
4. Rehashing	3.54	0.36	1.62	0.16
Location Parameters: y > 4	Threshold		Difficulty	

	Estimate	SE	Estimate	SE
1. Dwelling	3.65	0.40	2.09	0.21
2. Mutual	3.96	0.42	1.75	0.17
3. Speculating	2.76	0.26	1.81	0.19
4. Rehashing	5.21	0.58	2.39	0.27

Note: IFA = Item Factor Analysis; IRT = Item Response Theory; Factor loadings = change in logit (y) per unit change in theta; discriminations = slope at each difficulty value; thresholds = expected logit (y = 0) when theta is 0 (mean of sample); difficulties = theta at which probability of the next option is equal to .50.

Aim 2: Prospective Associations Among PTSS, Resting RSA, and Co-Rumination Components

First, a main effects path model was estimated in which dwelling on negative affect, mutual encouragement of problem talk, speculating about problems, and rehashing problems were simultaneously regressed on interview wave, gender, TORTE, resting RSA, and PTSS in order to determine unique associations (see Table 7 for full path model results). Note that all path model effects are unique effects of the predictor after controlling for its common variance with other predictors. PTSS was not significantly associated with any co-rumination component. There was a non-significant, trend-level association between youth PTSS and dwelling on negative affect (B = 0.16, SE = 0.08, p = .06). This main effect model resulted in a total R^2 of .05 for dwelling on negative affect. A significant path emerged for the link between TORTE and speculating on problems (B = 0.24, SE = 0.09, p = .01), with greater severity of exposure linked to greater engagement in this pattern. In addition, gender was significantly associated with rehashing problems (B = -0.35, SE = 0.15, p = .02), such that boys were more likely to rehash problems than girls. No other significant effects emerged.

Table 7

Full Path Model Results for Youth Posttraumatic Stress Symptoms Predicting Co-Rumination

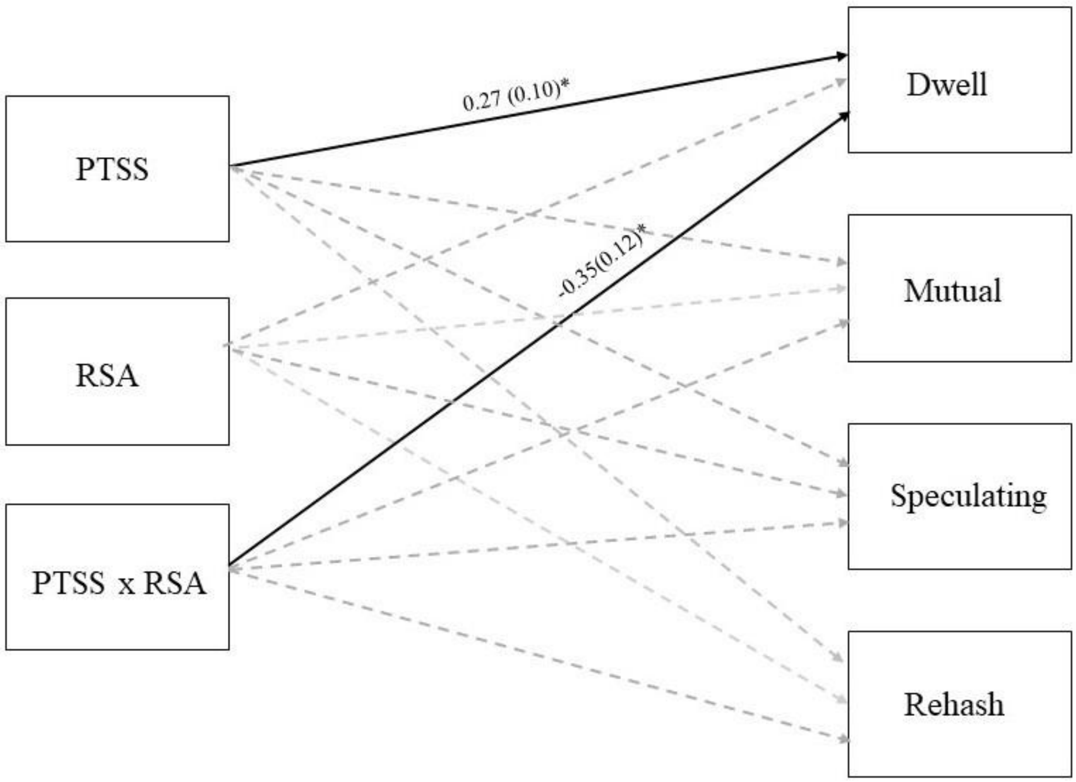
	Model 1: Main effects				Model 2: Interactive effects			
Variable	B	*SE*	*p*	R^2	B	*SE*	*p*	ΔR^2
Dwelling on Negative Affect				.05				.08**
Gender	-0.12	0.14	.39		-0.14	0.16	.37	
Wave	0.07	0.08	.34		0.10	0.09	.23	
TORTE	0.13	0.11	.24		0.08	0.12	.47	
PTSS	0.16[#]	0.08	.06		**0.27****	**0.10**	**.006**	
RSA	0.02	0.09	.84		-0.06	0.09	.51	
PTSS x RSA	–	–	–		**-0.35****	**0.12**	**.003**	
Mutual Encouragement of Problem Talk				.06				.02[#]
Gender	-0.33[#]	0.16	.05		**-0.34***	**0.16**	**.04**	
Wave	0.01	0.07	.87		0.03	0.08	.74	
TORTE	0.15[#]	0.08	.06		0.13	0.08	.11	
PTSS	0.05	0.08	.56		0.10	0.09	.24	
RSA	-0.13	0.08	.13		-0.17[#]	0.09	.06	
PTSS x RSA	–	–	–		-0.17[#]	0.10	.09	
Speculating About Problems				.06				.01
Gender	-0.15	0.16	.35		-0.15	0.16	.35	
Wave	0.04	0.08	.56		0.05	0.08	.50	
TORTE	**0.24***	**0.09**	**.01**		**0.22***	**0.09**	**.02**	
PTSS	0.03	0.08	.68		0.07	0.09	.44	
RSA	-0.07	0.09	.44		-0.09	0.08	.27	
PTSS x RSA	–	–	–		-0.11	0.09	.23	
Rehashing Problems				.09				.01
Gender	**-0.35***	**0.15**	**.02**		**-0.36***	**0.15**	**.02**	
Wave	0.10	0.08	.22		0.11	0.08	.19	
TORTE	0.16	0.11	.16		0.15	0.12	.22	
PTSS	0.12	0.08	.10		0.20[#]	0.10	.05	
RSA	-0.12	0.09	.15		-0.15[#]	0.09	.08	
PTSS x RSA	–	–	–		-0.12	0.10	.24	

[#] p <.10; *p < .05; **p <.01; ***p <.001; Bold font denotes significant coefficient estimates; Wave = wave of interview data collection; PTSS = posttraumatic stress symptoms collected at Wave 2; TORTE = severity of tornado exposure; resting RSA = resting respiratory sinus arrythmia collected at Wave 3

Next, as shown in Figure 4, the interaction between resting RSA and PTSS was added to the path model to determine if the impact of PTSS on the four co-rumination components depended on levels of resting RSA. A statistically significant effect emerged for this interaction in predicting dwelling on negative affect (B = -0.35, SE = 0.12, p =.003), suggesting that resting RSA moderated the association between PTSS and dwelling on negative affect. Interpretation of this interaction coefficient is as follows: For every additional unit of resting RSA, the PTSS slope (B = 0.27) becomes *less positive* by the interaction of -0.35. Thus, the interaction weakens the effect of PTSS, such that the slope for the expected change in dwelling on negative affect for each unit of PTSS is less positive for more physiologically regulated youth (smaller by 0.35 per unit of RSA). In other words, PTSS matters less for predicting dwelling on negative affect in more physiologically regulated youth. This interaction also explained a significant amount of additional variance compared to the main effects model ($\Delta R^2 = .08$, $p < .01$). Simple slopes of PTSS at 1 SD above and below the mean were then estimated (see Figure 5). PTSS was significantly associated with dwelling on negative affect at lower levels of resting RSA (*B* = 0.62, *SE* = 0.19, p = .002). In contrast, PTSS and dwelling on negative affect were unrelated at higher levels of resting RSA (*B* = -0.08, *SE* = 0.10, p = .43). No other moderating effects of resting RSA were found**.** Appendix B, Supplemental Table 1 presents IFA parameters for the interaction path model, including item thresholds for each binary submodel (0 vs 12345, 01 vs 2345, 012 vs 345, 0123 vs 45, and 01234 vs 5).

Figure 4

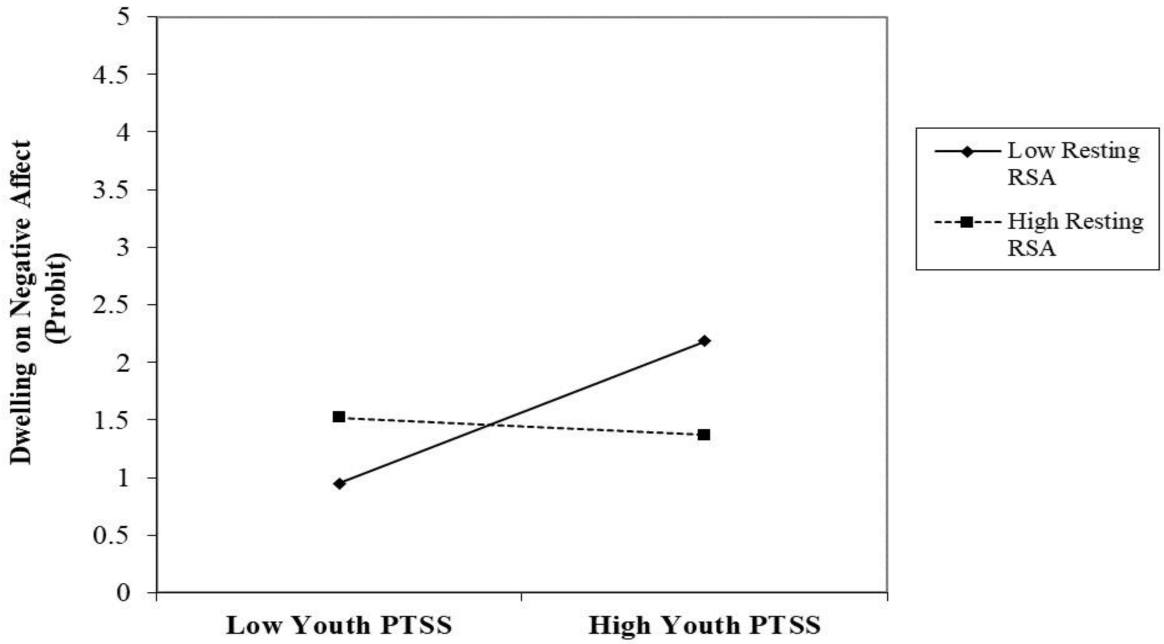
Estimated Path Model for Youth PTSS and Resting RSA Predicting Co-Rumination



Note: Dotted lines indicate nonsignificant path estimates. Covariances between all variables were included in the model (e.g., just-identified model, 0 df) but are not depicted for clarity purposes. In addition, gender, wave of interview data collection, and TORTE are included as covariates but not depicted here for clarity. PTSS = posttraumatic stress symptoms, RSA = resting respiratory sinus arrythmia, dwell = dwelling on negative affect, mutual = mutual encouragement of problem talk, speculating = speculating about problems, rehash = rehashing problems.

Figure 5

Resting RSA Moderates the Association Between Youth PTSS and Dwelling on Negative Affect



Note: High resting RSA = 1 standard deviation above the mean; Low resting RSA = 1 standard deviation below the mean. At low levels of resting RSA, youth PTSS was positively associated with dwelling on negative affect. At high levels of resting RSA, the association was not significant.

Gender Differences in Co-Rumination

A multiple-group path model was estimated to examine differences among all paths by gender (boys and girls). All parameters were initially estimated separately for boys and girls. Then sequential analyses to determine whether model paths differed by gender were conducted. These analyses used univariate Wald test of differences between single paths using the model constraint function in Mplus. See Table 8 for full model results. The interaction of PTSS and resting RSA in predicting dwelling on negative affect did not differ for boys and girls ($Z = 1.52$, $p = .13$). However, some gender differences in paths did emerge. For boys, the interaction effect of PTSS and resting RSA in predicting all outcomes was nonsignificant. For girls, the interaction of PTSS and resting RSA was significantly associated with mutual encouragement of problem talk (B = -0.74, SE = 0.27, *p* = .005), speculating about problems (B = -0.41, SE = 0.17, *p* = .02), and rehashing problems (B = -0.54, SE = 0.23, *p* = .02). Univariate Wald tests of differences demonstrated that the interaction paths were significantly stronger in girls compared to boys for these three outcomes.

Simple slopes of PTSS at 1 SD above and below the mean were then estimated for significant interaction paths for girls. Consistent with hypotheses, at low levels of resting RSA, PTSS was unrelated to mutual encouragement (B = 0.96, SE = 0.49, *p* = .05), speculating about problems (B = 0.36, SE = 0.35, *p* = .30), and rehashing problems (B = 0.77, SE = 0.46, *p* = .02). In contrast, at high levels of resting RSA, higher PTSS was significantly associated with lower levels of mutual encouragement (B = -0.52, SE = 0.20, *p* = .01), speculating about problems (B = -0.45, SE = 0.19, *p* = .02), and rehashing problems (B = -0.32, SE = 0.16, *p* = .04). In other words, PTSS predicts even less mutual encouragement, speculating about problems, and rehashing problems in more physiologically regulated girls.

Table 8

Multiple-Group Path Analysis Testing the Main Moderation Model by Gender (Boy vs Girl)

Effect	Model Outcome	Boys				Girls				Test of gender difference	
		Est	SE	*p*	Std	Est	Se	*p*	Std	Z	*p*
PTSS	Dwelling	-0.14	0.15	.36	-0.12	-1.07	0.59	.07	-0.77	1.52	.13
x	Mutual	0.10	0.13	.47	0.08	**-0.74****	**0.27**	**.005**	**-0.62**	**2.82****	**.005**
RSA	Speculating	0.09	0.17	.61	0.07	**-0.41***	**0.17**	**.02**	**-0.38**	**2.05***	**.04**
	Rehashing	0.14	0.20	.49	0.11	**-0.54***	**0.23**	**.02**	**-0.50**	**2.23***	**.03**

Note: **p* < .05; ***p* <.01. Bold font denotes significant coefficient estimates. Est = unstandardized coefficient estimates, SE = standard error, Std = standardized coefficient estimates, mutual = mutual encouragement of problem talk, speculating = speculating about problems, rehashing = rehashing problems, dwelling = dwelling on negative affect.

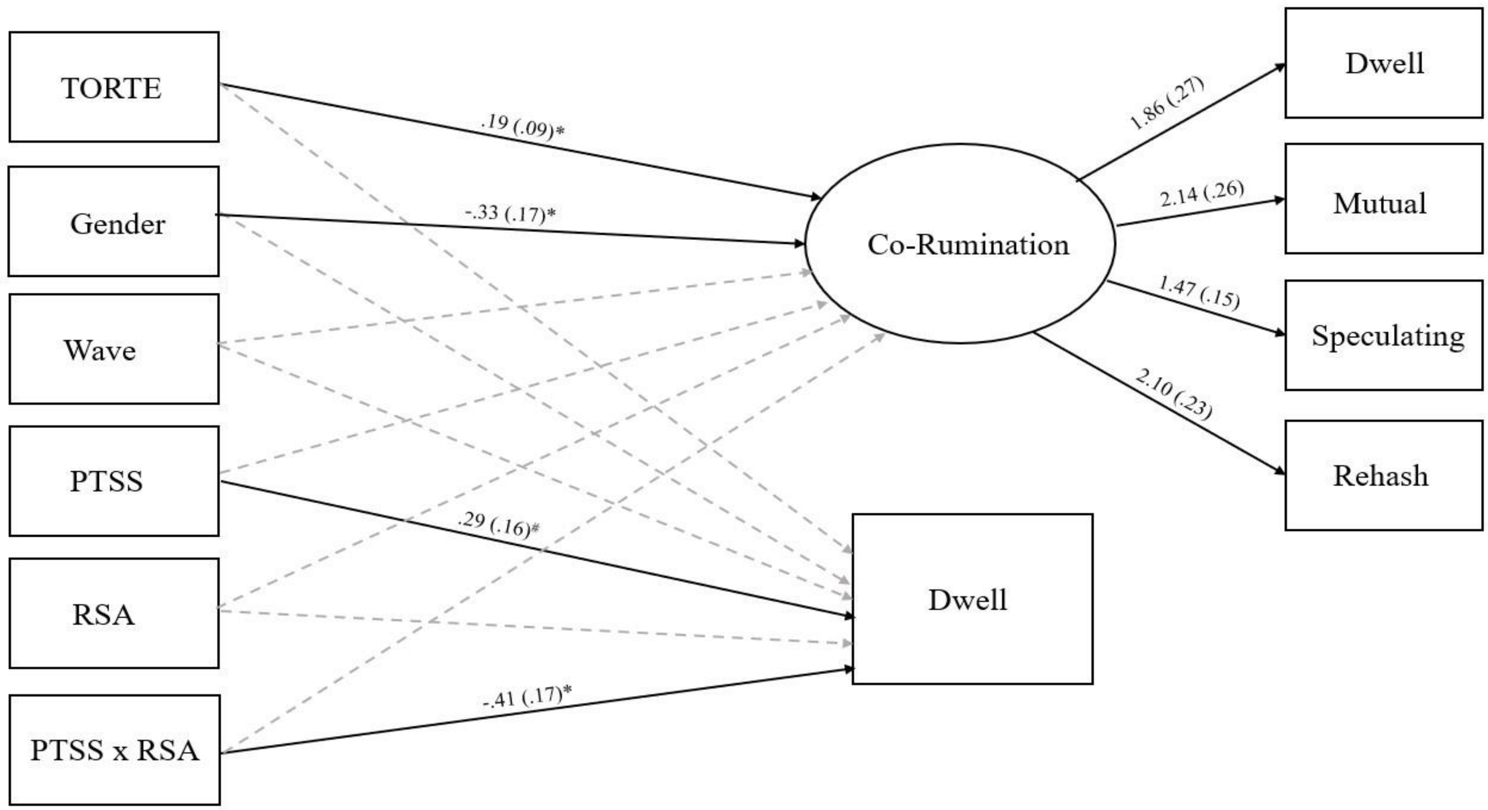
Supplemental Analyses: Structural Models with Latent Trait

The first structural equation model examined included the latent factor of co-rumination and observed variables of youth PTSS and resting RSA. Wave, gender, and severity of tornado exposure were included as covariates. The latent factor of co-rumination was estimated as described previously. This model had generally acceptable fit: χ^2 = 40.99, *p* = .02, RMSEA = .06, SRMR = .13, CFI = .99. No significant direct or interaction effects emerged.

A second structural equation model examined included the latent factor of co-rumination and the observed item of “dwelling on negative affect” as simultaneous outcomes of the predictors. All other co-rumination items were still in the model as indicators of the factor (see Figure 6). This model used Multiple Indicator Multiple Causes (MIMIC) modeling, which allows for estimating relations among observed and latent variables. In this case, MIMIC modeling was used to demonstrate whether effects unique for “dwelling on negative affect” remained after considering the effect of the predictors on variance shared with the latent factor. The latent factor of co-rumination was estimated as described previously. This model had acceptable fit: χ^2 = 40.27, *p* = .007, RMSEA = .07, SRMR = .05, CFI = .99. When considering the variance associated with all other variables and the latent factor, the interaction of PTSS x RSA was significantly associated with dwelling on negative affect (B = -.41, SE = .17, *p* = .02) but unrelated to the latent co-rumination factor (B = -.15, SE = .10, *p* = .13).

Figure 6

Path Model for MIMIC Model Predicting Co-Rumination Using the Latent Co-Rumination Factor and the Observed Item "Dwelling on Negative Affect"



Note: Dotted lines indicate nonsignificant path estimates. On the left side, unstandardized path coefficients and standard errors are shown. For the latent factor on the right side, loadings and standard errors are shown. Covariances between all variables were included in the model but are not depicted for clarity purposes. PTSS = posttraumatic stress symptoms, RSA = resting respiratory sinus arrythmia, dwell = dwelling on negative affect, mutual = mutual encouragement of problem talk, speculating = speculating about problems, rehash = rehashing problems. For gender, boy = 0 and girl = 1.

Discussion

Parents have an important influence on children's disaster recovery. Emerging evidence suggests that the qualities of parent-child conversations about their disaster-related experiences influence youth long-term disaster recovery. However, it has been challenging to identify families early on who may be most at risk for potentially maladaptive ways of communicating about their disaster experiences. This study extends existing research by first examining a certain quality of how parents and adolescents communicate called *co-rumination*, and then testing possible predictors of co-rumination several years following exposure to a devasting tornado. Overall study findings demonstrated that co-rumination can be identified and reliably measured in parent-adolescent conversations about their tornado experiences. Youth resting RSA (an index of physiological dysregulation) also moderated the association between youth post-disaster PTSS and the co-rumination component of "dwelling on negative affect" five years later, such that PTSS were associated with high levels of "dwelling on negative affect" only at low levels of resting RSA. PTSS and resting RSA were unrelated to the other elements of co-rumination (i.e., mutual encouragement, speculating about problems, and rehashing problems). These effects were found among a sample of youth initially recruited into the study due to their clinically elevated aggressive behaviors, suggesting that extensive discussion of negative emotion with a parent may be a particularly relevant conversation pattern among youth exhibiting high levels of aggression.

Measuring Co-Rumination in Parent-Adolescents Conversations

The first aim of the current study was to examine whether co-rumination and its four components could be observed and reliably measured in parent-adolescent conversations about a jointly-experienced natural disaster. To this end, this author evaluated basic psychometric properties of the co-rumination coding scheme adapted from existing research on observed co-rumination in friendship dyads (Rose et al., 2014). Parents and adolescents were given broad prompts intended to elicit conversation that would represent their general approach to discussing problems. As expected, the four components were significantly and positively correlated with one another (r's = .47 - .73) and these correlation coefficients were similar to those reported in previous studies of observed co-rumination (e.g., Rose et al., 2014). Mean levels of the four co-rumination components were similar to those reported in previous studies of observed co-rumination in friendships among adolescent dyads (e.g., Borowski & Zeman, 2018; Rose et al., 2014). All four co-rumination components demonstrated normal distribution and could be reliably coded (with ICCs ranging from 0.76 to 0.84). Further, and as expected, the four components loaded onto a single latent factor of co-rumination, suggesting that each component measures a distinct part of the larger global construct. This finding is consistent with past research that has demonstrated that the four co-rumination components load onto a single factor (e.g., Rose, 2002; Rose et al., 2014). Overall, results indicated that all four co-rumination components could be identified, reliably coded, and appear to vary in the parent-adolescent conversations.

Of note, measurement properties improved when using a modified 6-point Likert scale from 0 to 5. With the original 5-point Likert scale of 1 to 5, it was harder to identify and sensitively assess individuals on the low end of the latent co-rumination trait. However, when items were recoded using the 6-point Likert scale of 0 to 5, model fit indices, factor analyses parameters (i.e., item thresholds, discriminations, and difficulty), and reliability improved. The 0 category was meant to reflect those dyads who provided little to no content, such as stating "no effect" or "nothing happened". The modified coding with the added "0" category provides a more sensitive and reliable assessment of co-rumination, especially at the lower end of the trait. Thus, this coding scheme was retained for all subsequent analyses and the overall coding scheme was subsequently modified to incorporate the “0” category.

There is some precedent for using a global score of 0 to capture dyads who provided no content when discussing past events, such as saying nothing happened. Dunsmore and colleagues (2013, 2015) gave a score 0 if there was no evidence of parental encouragement or validation when parents and children discussed past family memories. Additionally, context is important when coding conversations. For example, a parent-adolescent dyad speaking about negative emotion is not necessarily, on its own, coded as high “dwelling on negative affect”. An adolescent may tell a parent about feeling scared during the tornado and then the dyad may discuss feeling safe now without further discussion of the negative emotion (low dwelling). On the other hand, an adolescent may perseverate on feeling scared, repeatedly bring up that same emotion throughout the conversation, and the parent may also validate and reflect the experience of that negative emotion (high dwelling). As such, the current study included a coding option of “0” in order to better capture the full range of co-rumination that considers both content and context.

Given that the conversation prompts in this study were not necessarily developed to elicit co-rumination, but to elicit open-ended conversations about tornado experiences, it is notable that co-rumination occurred in participants’ tornado conversations. For example, 30% of dyads received scores of 3, 4 or 5 for the component of “dwelling on negative affect”. Prompts used in conversation tasks can influence the content of these conversations (Hendrickson, 2016; Sun et al., 2016). In other studies of co-rumination in conversations, dyads were asked to identify an emotionally salient problem and then to speak about this top problem (Rose et al., 2014). In the current study, all dyads were given the same prompts and asked to speak about the same event—regardless of whether or not the tornado was a stressful experience for the dyad. Therefore, it is particularly unique that co-rumination was present in these conversations and that rates of co-rumination were generally consistent with rates found in other studies of observed co-rumination in friendship dyads (i.e., Byrd-Craven et al, 2008, 2011; Rose et al., 2014). Further, given the broad nature of the conversation prompts, it is possible that the recollections collected in this study could represent a typical way that the dyads talk about the tornado even outside of the study, perhaps enhancing generalizability of findings.

In sum, a notable contribution of the current study is the reliable identification of observed co-rumination among disaster-exposed parents and adolescents. This is also the first known study to measure observed co-rumination in parent-adolescent conversations. Previous studies have examined observed co-rumination in friendship dyads only (Borowski & Zeman, 2018; Byrd-Craven et al, 2008, 2011; Rankin et al., 2018; Rose et al., 2014). Factor analysis indicated that the four components are distinct, uniquely contribute to the latent co-rumination score, and the coding categories were differentiable and were used equally and reliably among all coders. As such, this coding scheme developed to measure parent-adolescent co-rumination appears to be a reliable tool that can tap into the four co-rumination components for individuals across all values of the latent co-rumination trait (i.e., low, medium, high co-rumination scores).

Resting RSA Moderated Link Between Youth PTSS and Dwelling on Negative Affect

The second aim of the current study was to test the prospective associations between two post-disaster youth-level qualities (PTSS and resting RSA) and co-rumination several years later. The goal here was to identify youth-level factors that may predict the quality of parent-child talk about their shared disaster experiences years later. Youth PTSS was positively associated with "dwelling on negative affect" at low levels of resting RSA. According to Polyvagal Theory, low levels of resting RSA indicate reduced regulation at rest (Beauchaine, 2001; Porges, 1995). Thus, this finding suggests that youth with elevated post-disaster PTSS are more likely to co-ruminate when they are physiologically aroused or dysregulated at rest. Lower levels of resting RSA support the profile of "dwelling on negative affect" as an emotion-based form of communication that reflects underlying dysregulation. This finding is also consistent with past research that has found that physiological arousal is related concurrently to "dwelling on negative affect" (Byrd-Craven et al., 2008, 2011). Physiological dysregulation may foster excessive focus on negative emotional experiences, setting the stage for co-rumination over time.

Further examination of the moderation effect revealed that at high levels of resting RSA, which is thought to reflect better emotion regulation, there was no association between PTSS and "dwelling on negative affect". This indicates that, among adolescents with better physiological regulation, adolescents' disaster-related PTSS was unrelated to parent-child co-rumination. Thus, resting RSA appears to be a particularly important physiological factor that influences the association between post-disaster PTSS and quality of parent-child talk among disaster-exposed youth. Adolescents with higher PTSS, and who failed to apply the vagal brake at rest, were more likely to engage in the co-rumination component of dwelling on negative affect.

It is important to note that although interactions between PTSS and resting RSA predicted co-rumination, only a trend-level main effect ($p < .10$) was found for youth PTSS in predicting "dwelling on negative affect". This non-significant association is surprising given previous research support of the link between higher internalizing symptoms and subsequent co-rumination (e.g., Felix et al., 2020; Rose et al., 2014). In the present study's at-risk sample, these results highlight the importance of considering other factors, such as physiological dysregulation, when examining the link between PTSS and co-rumination. It is also notable that only 16% of the study sample demonstrated clinically significant levels of PTSS (scores ≥40) within the first 6 months following the tornado. Indeed, although youth reported a range of PTSS symptoms (scores of 0 to 68), and 42% reported perceived life threat during the tornado, many youth in the current study did not cross the threshold for clinically impairing PTSS. Present results might have differed in a sample of adolescents in which a larger percentage of youth demonstrated clinically significant PTSS post-tornado.

Much of the literature on co-rumination has focused on the link between co-rumination and later mental health concerns—or has looked at the concurrent link between co-rumination and mental health symptoms (Hankin et al., 2010; Rose et al., 2017). This study provides preliminary evidence that early post-disaster PTSS and low resting RSA (indicative of poor emotion regulation) were *interactively* associated with later co-rumination in parent-child dyads. However, they were only associated with “dwelling on negative affect” and not the other co-rumination components of rehashing problems, speculating about problems, and mutual encouragement of problem talk. As such, we can begin to answer the question: “who are these youth who are most likely to co-ruminate about their disaster experiences years later?” Youth who are both psychologically and physiologically dysregulated appear most likely to engage in “dwelling on negative affect” with a parent even years after the disaster event. It may be that physiologically dysregulated youth are less able to modulate their distress and are more likely to perseverate on negative emotional experiences. These youth may also be more likely to notice threatening aspects of their environment, demonstrate prolonged distress or recurrent memories of the event, or have persistent negative cognitions or emotional states (Lai et al., 2017; Masten, 2021).

Other elements of co-rumination, including rehashing problems, mutual encouragement of problem talk, or speculating about causes or consequences, were unrelated to post-tornado youth PTSS and physiological arousal. This may be because these other components rely more on parent-directed guidance and problem-solving and are more analytical and less emotionally charged or valanced than the "dwelling on negative affect" component. Higher ratings on these components tended to reflect more validation and sharing of positive experiences. For example, mutual encouragement of problem talk included engaged responses such as sharing a related experience, offering information or an opinion, or generating a possible solution. Similar patterns were found in speculating about problems, with more of a focus on potential consequences and causes of events. Dyads with high levels of rehashing, mutual encouragement, and speculating, tended to respond to each other with engaged responses that extended the conversations and may have indicated interest in the conversation partner. These conversations were also mostly focused on problem solving or processing the sequence of events or situational outcomes. Although we cannot test this directly in the current study, it may be that these engaged responses facilitated relational closeness and positive relationship quality. In contrast, the extensive focus on negative emotion experiences—common to dwelling on negative affect—may reflect an overprocessing of the negative or stressful experiences and may also be an indicator of cognitive rumination (Nolen-Hoeksema, 1991).

The Value of Examining the Co-Rumination Components Separately

This study provides strong conceptual and psychometric rationale to examine the co-rumination components separately, even though the four components loaded onto a single factor. At first glance, factor analysis results might suggest using the total co-rumination latent factor rather than looking at the component parts. However, there are several compelling reasons for evaluating the distinct elements of co-rumination. First, previous studies have found that only "dwelling on negative affect" is associated with youth anxiety and depression (Rose et al., 2014) and physiological arousal (Byrd-Craven et al., 2008, 2011) even after controlling for the other components. Second, in the current study, only "dwelling on negative affect" was associated with the interaction of PTSS and resting RSA. Third, when the latent co-rumination factor was used as an outcome in the path model, no significant effects were found. Fourth, study results revealed that the interaction of PTSS and resting RSA predicted "dwelling on negative affect" even after considering the variance shared with the latent factor. Thus, this effect appears to be particularly strong and holds above and beyond variance shared by the other components on the latent trait. Unique information about how co-rumination may operate in parent-child dyads was elucidated by examining the components separately—information that would not be identified by examining the components all together as a global score.

Gender Differences

Although resting RSA moderated the effect of youth PTSS on "dwelling on negative affect", the interaction effect did not differ by youth gender. This pattern is surprising at first glance and contrasts with the existing literature in which girls are more likely to co-ruminate with their mothers compared to boys (Waller & Rose, 2010). One possibility is that there may be culturally-specific differences in co-rumination, and other communication styles, to consider. Previous studies have examined co-rumination in mainly White samples and the sample in the current study was predominantly African American. Culture and ethnicity can influence beliefs about emotions and the emotion socialization strategies that parents use with their children (Dunbar et al., 2017). Another possibility is that gender differences may not be as prominent in a sample originally recruited because of their aggressive behaviors. Indeed, overall mean levels of “dwelling on negative affect” were the same for boys and girls in this sample. Aggressive youth may be more likely to focus on negative emotions of frustration or anger or have difficulties with emotion regulation, regardless of gender (e.g., Peled & Moretti, 2007; Martinelli et al., 2018). Other studies have found a link between anger rumination and aggression among adolescents in both boys and girls (Peled & Moretti, 2007). Anecdotally, in the current sample, both boys and girls brought up negative emotions such as feeling scared and sad, but also feelings focused on frustration or anger.

It is worth noting that the interaction of PTSS and resting RSA was significantly associated with the other three components of co-rumination (i.e., mutual encouragement, speculating about problems, rehashing problems) for girls but not for boys. Yet simple slopes revealed that this pattern is still generally consistent with hypotheses. That is, youth PTSS and these components of co-rumination were unrelated at low resting RSA (i.e., physiological dysregulation). The difference emerges at high levels of resting RSA (i.e., physiological regulation): higher PTSS was associated with lower levels of mutual encouragement, speculating about problems, and rehashing problems at high levels of resting RSA. This result indicates that PTSS appears to matter less in predicting mutual encouragement, speculating about problems, and rehashing problems for physiologically regulated girls. Resting RSA is a particularly important factor that influences rates of co-rumination.

Clinical Implications for Talking with Adolescents About Disasters

The National Child Traumatic Stress Network (nctsn.org) provides guidelines for talking with children about disasters. However, these are mostly focused on suggestions for initial recovery. For example, interventions such as Psychological First Aid (Vernberg et al., 2008) or Skills for Psychological Recovery (NCTSN, 2020) emphasize promoting a sense of safety, selfefficacy, and connectedness in the crisis response phase (see also Vernberg et al., 2016). Less guidance exists regarding how to talk to children in the months and years following disaster exposure. Parent-child communication about their disaster experiences is common and plays a nuanced role in youth long-term disaster recovery. Previous work with this sample and other disaster-exposed samples has found that the quality of parent-child talk about their disaster experiences influences youth posttraumatic adjustment. For example, parent egocentrism (Hendrickson et al., 2020) and over-focus on negative emotions (Abel et al., 2020) are associated with sustained PTSS and anxiety symptoms. In contrast, in another sample of disaster exposed school-aged children, parent acknowledgment was protective (Abel et al., 2021). For these children, parent validation and acknowledgment of thoughts and feelings potentially created an environment in which they felt heard and received guidance processing their thoughts and feelings. This is consistent with Miller-Slough and Dunsmore's (2016) model of emotion socialization in which parent's socialization responses are marked by a combination of high or low engagement and high or low guidance. In the context of co-rumination, especially about negative emotion content, parents and children may not use problem solving skills or seek out resolutions and effective coping strategies. This is particularly true for the component of dwelling on negative affect, in which parents and children will focus on negative emotion content without necessarily finding solutions or identify coping skills.

This is not to say that parents should *not* talk about negative emotions with their children. Rather, the quality of the emotion talk seems particularly important. For example, emotion talk that includes problem solving, solutions, and resolutions appears to be protective for youth (Abel et al., 2020, 2021; Hambrick et al., 2018; Legerski et al., 2015). One takeaway is that co-rumination may not always be maladaptive and that certain elements of co-rumination may foster emotional closeness, which can be protective for youth following disaster exposure. Results from the current study suggest that early post-disaster youth-level factors are important to consider when helping families to converse about disaster experiences. PTSS and resting RSA can be used to identify those youth who may continue to dwell on negative emotional experiences with a parent even years after exposure. It may also be helpful to limit dwelling on negative emotions only for those youth who initially present with high baseline levels of PTSS or physiological dysregulation.

It is notable that youth in this study were at risk because of their initial levels of elevated aggression. Youth with a pre-existing mental health vulnerability may be especially likely to dwell on negative affect because of difficulties with self-regulation. For example, aggressive youth may be more likely to notice negative aspects of their environment or make hostile attributions, contributing to higher rates of “dwelling on negative affect” over time. This may be particularly true for reactively aggressive youth, a type of aggression that is conceptualized as an emotional reaction to perceived threat (Dodge & Coie, 1987). As such, study results have particular implications for aggressive youth who may need mental health services following disaster exposure. For example, clinicians may want to screen for disaster-related PTSS or resting RSA as these markers may have implications for later parent-child communication styles and could inform treatment targets for these youth.

Limitations, Strengths, and Future Directions

There are some limitations to this study that warrant attention and may guide future research. First, item difficulty (i.e., latent trait value at which probability of the next scoring option is equal to .50) from the IFA model was weaker for “dwelling on negative affect” compared to the other three components. This means that it was harder for coders to differentiate a 1 vs. 2 or 2 vs. 3 when coding “dwelling on negative affect”. However, this item is needed so that the factor analysis can be identified. Further, the item is adequate as there is still a point on the latent trait at which each answer is most likely and the discrimination value is greater than 0. Second, we were unable to examine how the new measure of co-rumination in conversations correlates with the existing Co-Rumination Questionnaire (CRQ; Rose, 2002). This will be an important next step in order to establish validity of this measurement tool. Third, with regards to coding, we did not assess who brought up the topic first (i.e., parent or adolescent). Thus, it is not clear who is driving the co-rumination. Nonetheless, the codes still reflect a dyadic process and high scores were only given when both parents and adolescents provided content and/or kept the conversation going.

Fourth, as is common in much of the trauma recollection literature, all parents in this study were mothers. Previous studies have found that mothers and father co-reminisce differently with their children (Brand & Klimes-Dougan, 2010; Miller-Slough & Dunsmore, 2016). Examining how fathers and other caregivers communicate with children about disasters is an important next step in the disaster literature—especially given the role that the family plays in youth post-disaster adjustment. Fifth, we did not examine the link between co-rumination and later mental health outcomes. However, it is possible that co-rumination shortly following the disaster may contribute to sustained PTSS over time and this is another area for future study. Finally, it is notable that youth in this study received a preventive intervention for aggressive behaviors. This is both a strength and a limitation as youth may have learned coping skills from the intervention that lowered rates of PTSS and co-rumination. Future research should evaluate these conversation patterns, and the co-rumination coding scheme, in a community sample in order to increase generalizability of findings.

Despite these limitations, this study helps to fill several important gaps in the literature. First, this is the first known study to measure co-rumination with parents in conversations. An observational approach allows for a more nuanced evaluation of how parents and children communicate about their disaster experiences. Although previous studies have examined disaster co-reminiscing via observational measures (e.g., Abel et al., 2020, 2021; Hendrickson et al., 2020), no studies have looked at co-rumination specifically. Second, few studies have explored youth's physiological responses to disasters, and those that have often conduct assessments at one time-point, thereby limiting our ability to establish directionality of the association between physiological arousal and disaster response. This is the first prospective study to examine whether early post-disaster physiological dysregulation and PTSS are risk factors for later co-rumination in conversations with a parent about their disaster experiences. Third, the study sample is predominantly African American and low income. Culture and race/ethnicity can influence beliefs about emotions and the ways in which parents and adolescents communicate about their emotions and past experiences. For example, display of negative emotion may be less acceptable in some contexts because of negative social consequences and this is especially true for African American male adolescents (Nelson et al., 2012). As such, traditionally unsupportive socialization strategies, such as minimizing or emotion dismissal, may actually be supportive and culturally adaptive in some contexts (Cole & Tan, 2007). The examination of co-rumination in this sample is an important contribution to the trauma recollection and co-reminiscing literature given the lack of studies that have been conducted with non-White, lower-income samples in this area.

Fourth, much of the co-reminiscing literature has been conducted with school-aged samples and this study examined a sample of adolescents. Helpful and unhelpful patterns of parent-youth communication vary as children age (see Miller-Slough & Dunsmore, 2016). Within the disaster literature, some traditionally supportive communication patterns—such as parent validation and acknowledgment of negative emotions—were helpful for school-aged children (Abel et al., 2021) but associated with more mental health concerns for adolescents (Abel et al., 2020). It is possible that for adolescents, validation of negative emotions maybe perceived as an overprocessing of these negative emotions rather than the more supportive scaffolding and "feeling heard" that is common with younger children. Regardless, it is unclear if co-rumination may serve a similar function for all youth and possible developmental differences should be explored in future studies. Finally, to continue to develop an evidence-base around post-disaster family communication, intervention work to improve post-disaster parent-child communication is needed.

Summary

This study provides preliminary evidence establishing the co-rumination coding scheme measurement properties in a sample of parents and adolescents exposed to a devasting EF-4 tornado. The coding scheme in this study, adapted from the observational co-rumination coding scheme in friendship dyads in a majority-White adolescent sample (Rose et al., 2014), is the only available measure of observed parent-child co-rumination in conversations. For parents and adolescents exposed to a devasting tornado, a one-factor structure corresponding to a global co-rumination score, with items coded on a 0 to 5 scale, best captures co-rumination at a global level. The four items also uniquely and distinctly contribute to the global construct of co-rumination. This provides preliminary evidence of the validity of this observational coding scheme. Results also indicated that there are unique associations between select youth-level risk factors and the distinct components of co-rumination. Youth post-disaster PTSS was associated with “dwelling on negative affect” for youth with poor physiological regulation at rest (i.e., low resting RSA), suggesting that physiological dysregulation is an important contributor to co-rumination in conversations and particularly to “dwelling on negative affect”. These are adolescents who have all been exposed to a devastating tornado and have a similar pre-existing mental health vulnerability (i.e., aggressive behaviors), but it is the interaction of PTSS and physiological dysregulation that make them prone to “dwelling on negative affect”. It may be that arousal contributes to hypervigilance and a consequent hyper-awareness of negative aspects in one’s environment—patterns that are common when co-ruminating with others. Understanding factors that influence long-term post-disaster adjustment is critical so post-disaster interventions can be developed and targeted to those who most need them. The results of this study represent an important step in this direction.

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Appendix A

Parent-Adolescent Co-Rumination Coding Protocol

General Guidelines for Coding

1. *Before* attempting to code, listen to ENTIRE interview first
2. Always listen to the audio and follow along with transcript
3. Listen to entire interview as many time as needed, pausing and rewinding when necessary
4. Make comments in document to justify score

CO-RUMINATION CODING DEFINITIONS

Co-rumination is defined as talking extensively about emotions and problems with a partner and is characterized by (a) dwelling on negative affect, (b) mutual encouragement of problem talk, (c) rehashing problems, and (d) speculating about problems (Rose, 2002). The following scale is used for all components. Specific details and examples about how to apply each of these values to the individual constructs is also provided.

0. Said "nothing happened" or "no effect"
1. Not at all/very little
2. A little
3. A moderate amount
4. A lot
5. Very much

*Note that the co-rumination coding scheme used here was adapted and modified by this author from previous observational research that captured co-rumination in friendship dyads (see Rose, Schwartz-Mette, Glick, Smith, & Luebbe, 2014).

Dwelling on Negative Affect

One or both members of the dyad focus on the experience of negative emotions like feeling worried, nervous, irritated, sad, anxious, angry, depressed, low, scared, distressed, anguished, shameful, embarrassed, frustrated etc.

0. Did not speak or stated that "nothing happened" or there was "no effect"
1. Little or no dwelling on negative affect. Parent and adolescent may speak about own emotions, but only to reflect or describe their experience of the event to each other. They may mention their own feelings but do not focus on them. Emotion may only be mentioned one time (or not at all). Alternatively, an emotion may be mentioned by one individual in the dyad and then the partner does *not* subsequently comment on, or reflect, that emotion.
2. Parent and/or adolescent mention their own feelings – including own perceptions of feelings about the situation – but do not become overly distressed or go into a lot of detail. Parent or adolescent may ask a question or make a comment about the emotion.
3. Parent and/or adolescent ask questions about emotion throughout the conversation or make follow-up statements about emotion. For example, the adolescent may make a statement about a negative emotion and the parent may reflect that emotion (e.g., "Yeah, you looked pretty shook up) and then ask a follow-up question (e.g., "Do you worry about weather now?"). One or both individuals may express sympathy for the other's feelings, offer comfort or support, or empathize with the other's feelings. This includes asking questions or validation ("Yes, that was scary.").
4. High degree of dwelling on negative affect. Responses to problem statements involve the encouragement of expression of negative emotion through matching, escalation of that emotion, or expanding on expressed emotion. This differs from validation or reflection of emotion (as indicated by a score of 3) because the partner is expressing their own emotion and/or adding additional emotional content. In other words, the partner is magnifying, matching, or escalating the experience of emotion. Examples include:
    - **a.** Expression of emotion or problem segments that include "we" (e.g., "We get really nervous when we hear about bad weather coming").
    - **b.** Self-focus or centering the conversation around him/herself (e.g., "I am sad too. It's been very stressful for me. I was scared too.").
    - **c.** Expanding the topic or adding more details that exacerbate the emotion (e.g., "And then we went outside and it was just like a scary movie…cause no one was out there.")
    - **d.** Inappropriate sharing of emotion from the parent.

5. High level of dwelling on negative affect. Parent ***and*** adolescent focus on negative emotions and repeatedly bring up the emotion content. For example, one person may bring up a negative emotion at the beginning of the interview and then bring up the same negative emotion experience at the end of the interview. There is little to no evidence of problem solving or finding resolutions or solutions to problems. The same criteria used for a score of 4 also apply here. The difference between a score of 4 and 5 include the ***repeatedly bringing up the same content in response to several prompts or spending several turns on the discussion of the same emotional experience.***

Mutual Encouragement of Problem Talk

One or both members of the dyad keeps the problem talk going instead of talking about other issues. One or both may also try to get the other to talk about the problem again after the topic has been switched. ***This code does not pertain to discussion of emotion.***

0. Did not speak or stated that "nothing happened" or there was "no effect
1. Little or no mutual encouragement of problem talk. Parent and adolescent may speak about own problems, but only to reflect or describe their experience of the event to each other. They may mention a problem, but do not focus on them. Discussion of problems are in an effort to share a joint or individual experience. Problems are only mentioned one time (or no problems are mentioned at all) and the partner does not add to or comment on that problem.
2. Parent and/or adolescent mention their own problems but do not go into a lot of detail. Parent or adolescent may ask a question or make a comment about the problem.
3. Parent and/or adolescent ask more than one question about problems throughout the conversation, ask follow-up questions, or make follow-up statements about problem. Parent or adolescent may ask several questions about the same problem in an effort to encourage the other to keep talking or sharing more details. For example, the adolescent may make a statement about a problem and the parent may reflect that experience (e.g., "Yeah, you went into the bathroom) and then ask a follow-up question (e.g., "And then what happened?"). One or both individuals may express sympathy for the other's experiences, offer comfort or support, or empathize with the other's experiences. This includes asking questions or validation ("Yes, that was hard.").
4. High degree of mutual encouragement of problem talk. Responses to problem statements involve the continued discussion of the same problem through reflection, validation, adding additional information, or asking follow-up questions. This differs from a score of 3 because the partner is adding additional content or asking questions **in order to keep the conversation going.** Examples:
    a. Response to a problem segment that includes a "we" (e.g., "Then we had to get into the hallway and I pulled a mattress over you.").
    b. Expanding the topic or adding more details.
5. High level of mutual encouragement of problem talk. Parent ***and*** adolescent spend a significant portion of the interview focusing on the same problem by asking each other questions about the problem or making comments about the other person's experiences.

Rehashing Problems

One or both members of the dyad talks about the problems or parts of the problems over and over again. This code is distinct from Mutual Encouragement of Problem Talk because there may be no effort to expand on the problem or process the problem together. Rather, the dyad repeatedly or extensively discusses *the same* details.

0. Did not speak or stated that "nothing happened" or there was "no effect"
1. Little or no rehashing problems. Parent and adolescent may speak about own problems, but they only do so one time and then move on to a new topic. Discussion of problems are in an effort to respond to the prompt and provide basic information about their experiences. Problems are only mentioned one time (or no problems are mentioned at all) and the partner does not add to, ask questions about, or comment on that problem.
2. Parent and/or adolescent mention their own problems but do not go into a lot of detail. Parent or adolescent may make a few comments about the problem or add minimal/some details about the problem.
3. Parent and/or adolescent mention the same problem several times, either by reflecting something that the partner said or validating something that the partner said. The partner may ask a question about recalling certain aspects of the event: (e.g., "Remember when you had to share a room with your cousins and it was so crowded"). Parent and adolescent spend several turns of speech discussing the same problem.
4. High degree of rehashing problems. Responses to problem statements involve the continued discussion of the same problem through reflection, validation, adding additional information, or asking follow-up questions. This differs from a score of 3 because the dyad will bring up the same problem in response to 2 or more of the prompts.
5. High level of rehashing problems. Parent ***and*** adolescent spend a significant portion of the interview focusing on the same problem by asking each other questions about the problem, making comments about the other person's experiences, and adding details to the problem. The dyad may either spend several turns discussing the same problem and have difficulty moving on to another topic or bring up the same problem several segments later (and also in response to another prompt). The parent and/or adolescent may appear distressed or have difficulty shifting topics, and perseverate on the same details for a long time. For example:

Prompt 1:

Child: And then when I wanted to go somewhere I couldn't just go because we didn't have transportation that we have now to do that.

Parent: Yea, it took our car and then, you know, someone went and stole the car, left the house and stole the car from under the garage. I had to walk to work so…

Prompt 2:

Parent: It's not safe for us not having a car.

Speculating about Problems

One or both members of the dyad ponder the origins of the problem or parts of the problem, why people did what they did, or what may happen as a result.

Things to look for that may indicate speculating about problems:

A. Making a resolution (e.g., the problem was solved). In this study, the tornado was considered to be the "problem". A resolution is only scored if there was some mention of difficulty or struggle and then things getter better.

B. Change because of the event ("we got to move into a new house"; "people sent us presents"; "my house got blown down").

C. Personal impact of the event (references to psychological or relational impact that the event has on the speaker). For example: "this memory makes me feel bad"; "I get to see my dad more"; "I made new friends"; "I lost my faith in God".

D. Lessons learned

E. Origins of the problem (e.g., reasons why it happened)

The focus should be on the <u>dyadic process of discussing problems and outcomes</u>, including outcomes that actually came to fruition, things that may not yet have happened, and things that could have/should have happened.

0. Did not speak or stated that "nothing happened" or there was "no effect"
1. Little or no speculating about problems. Parent and adolescent may speak about own problems and then move on **<u>OR</u>** no mention of any problems.
2. Parent and adolescent mention their own problems and then may mention **one thing** that may happen next or something that they learned from the event. They may mention something positive (e.g., became closer) or negative (e.g., we are still scared) that has come out of the experience of the tornado, but they do not spend a significant amount of time discussing outcomes.
3. Parent and adolescent attempt to resolve problems in the interview. Some mention of difficulty or struggle and then things getting either better or worse. There must be some reference to an outcome occurring, including making meaning out of their experience, gaining something new (e.g., moving or gaining a new sibling). **Important: there must be some back and forth between parent and adolescent.**
4. High degree of speculating about problems. Responses to problem statements involve the continued discussion of the same problem and outcomes or origins of this problem. There may be extensive references to change, reflection of benefit or negative effect of the event, or consequences of the event. This differs from a score of 3 because the parent and adolescent must spend several turns discussing the same outcome to, or origin of, one problem.
5. High level of speculating about problems. Parent and adolescent spend a significant portion of the interview focusing on the same problem(s) and how problem(s) were resolved (including positive and negative impact, change, personal impact, or origin of problem).

Appendix B

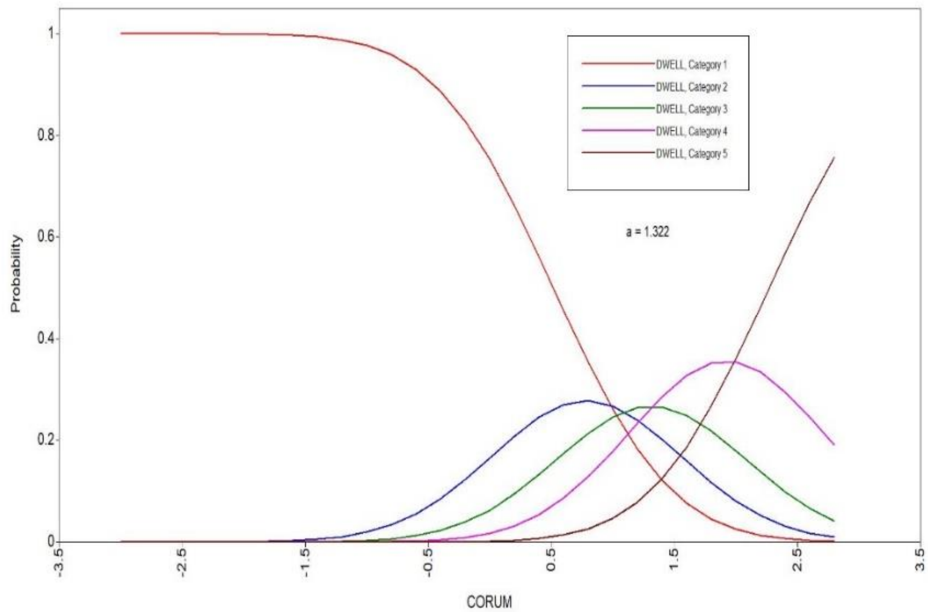
Supplemental Table 1

IFA Parameters for Interaction Path Model

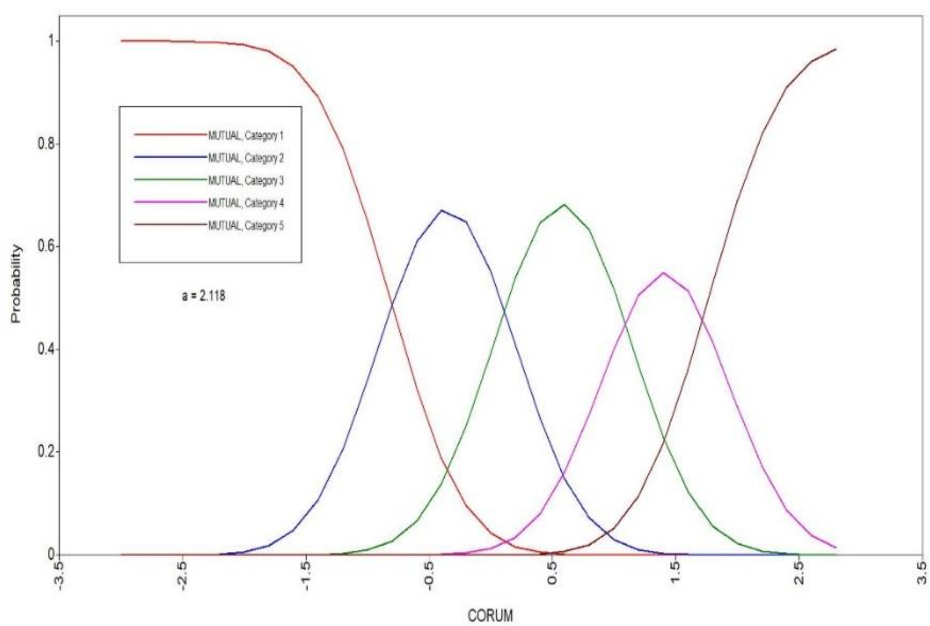
	Threshold	
Location Parameters: y > 0	Estimate	SE
1. Dwelling	-1.51	0.16
2. Mutual	-1.53	0.15
3. Speculating	-1.45	0.15
4. Rehashing	-1.55	0.15
	Threshold	
Location Parameters: y > 1	Estimate	SE
1. Dwelling	0.37	0.11
2. Mutual	-0.89	0.12
3. Speculating	-0.44	0.11
4. Rehashing	-0.32	0.11
	Threshold	
Location Parameters: y > 2	Estimate	SE
1. Dwelling	0.82	0.12
2. Mutual	-0.03	0.11
3. Speculating	0.41	0.11
4. Rehashing	0.64	0.11
	Threshold	
Location Parameters: y > 3	Estimate	SE
1. Dwelling	1.23	0.14
2. Mutual	0.86	0.12
3. Speculating	1.03	0.12
4. Rehashing	1.42	0.15
	Threshold	
Location Parameters: y > 4	Estimate	SE
1. Dwelling	1.86	0.19
2. Mutual	1.54	0.16
3. Speculating	1.51	0.15
4. Rehashing	2.15	0.25

Supplemental Figure 1

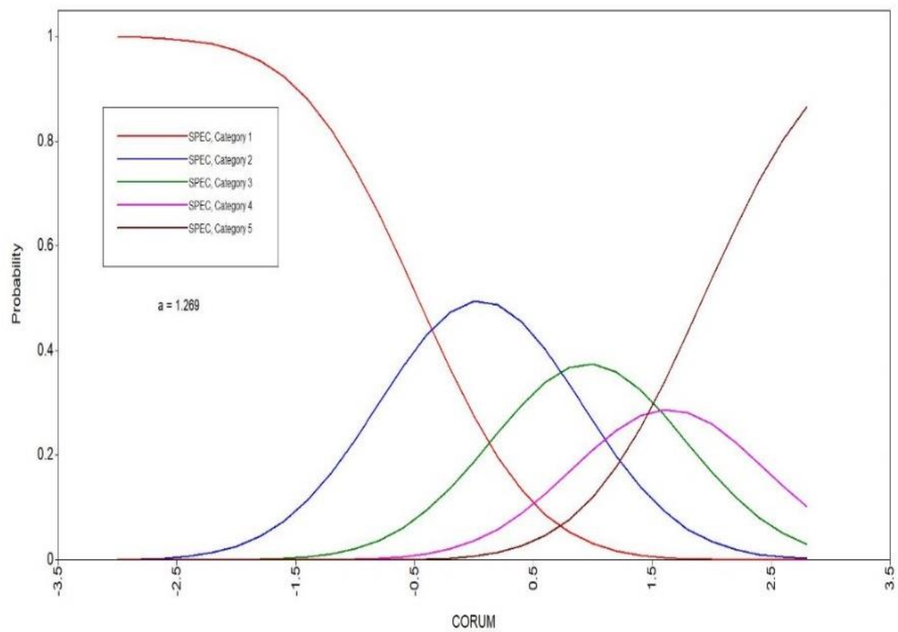
Category Response Curves for Original 5-Point Likert Scale



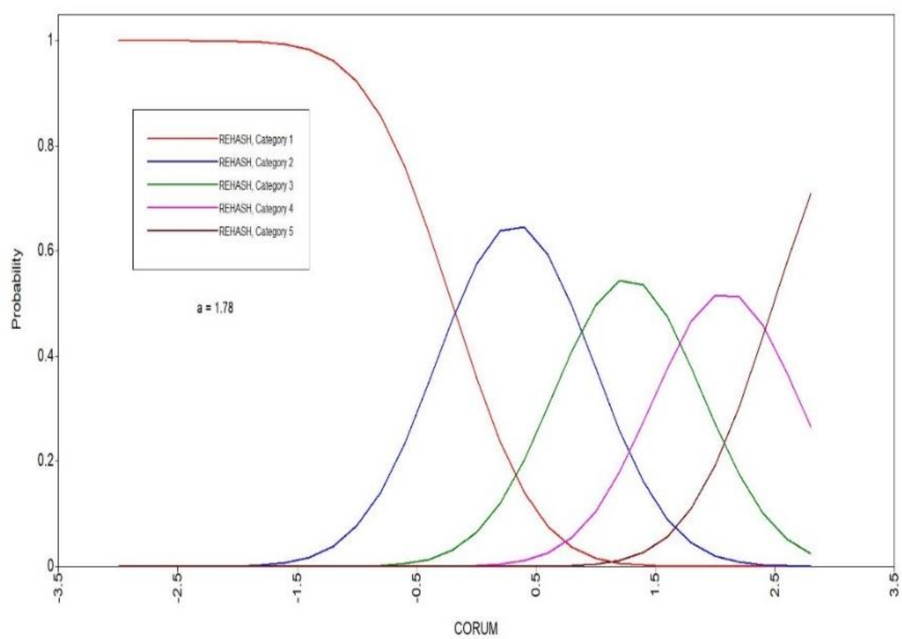
Note: (a) "dwelling on negative affect"



Note: (b) "mutual encouragement of problem talk"



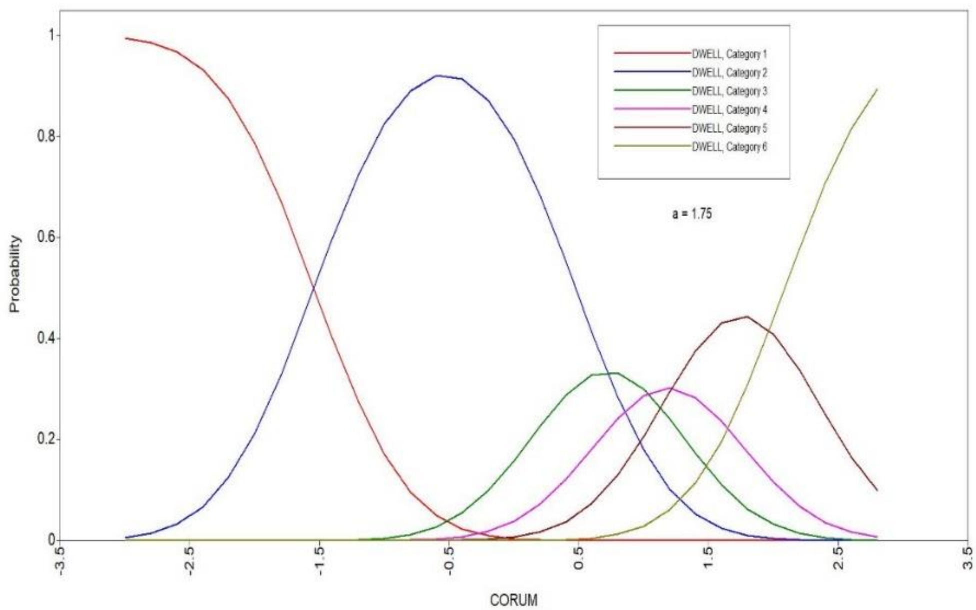
Note: (c) “speculating about problems”



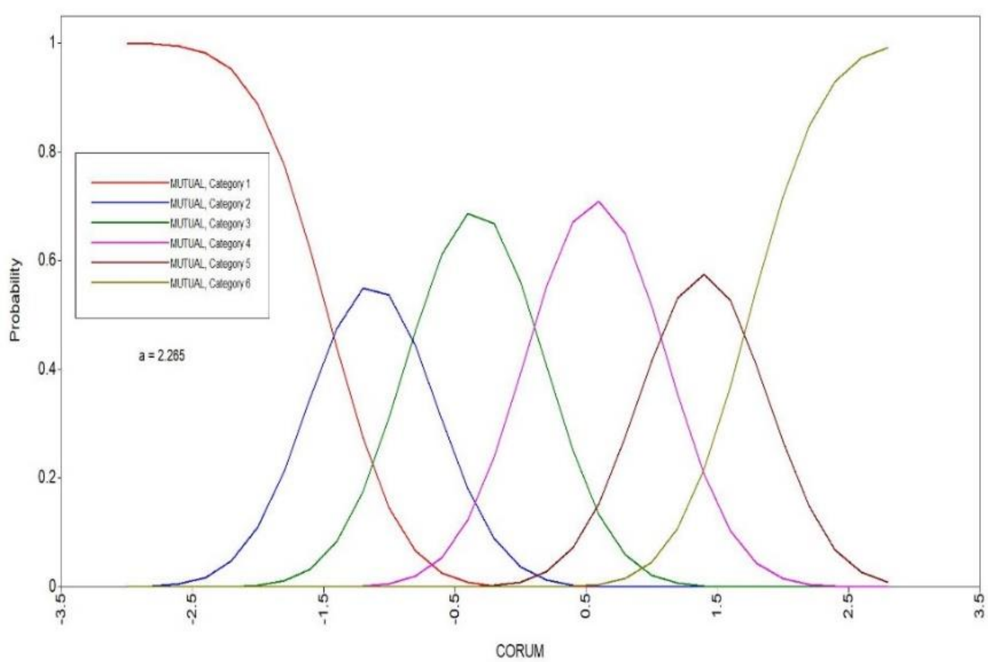
Note: (d) “rehashing problems”

Supplemental Figure 2

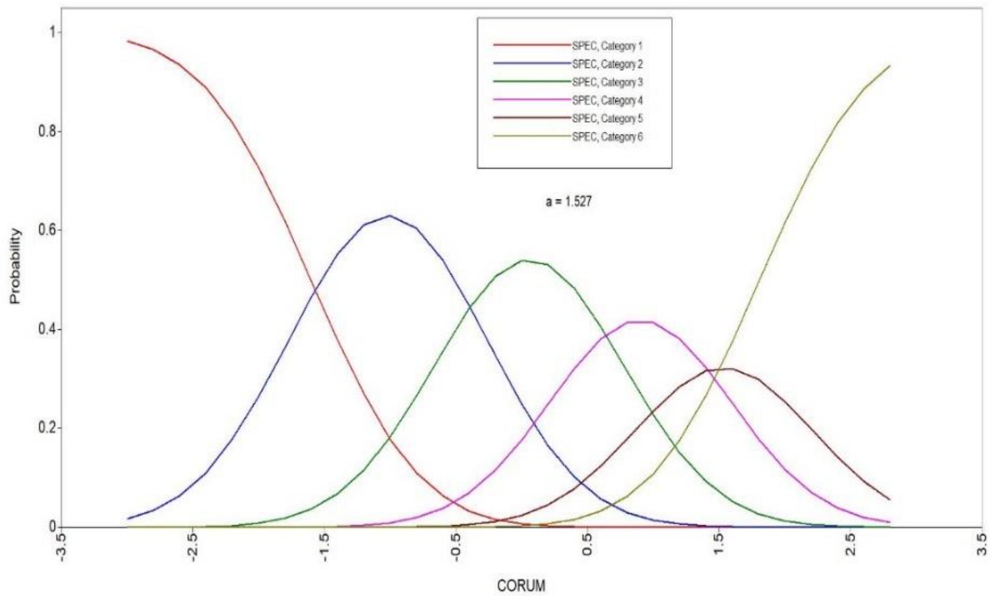
Category Response Curves for Modified 6-Point Likert Scale



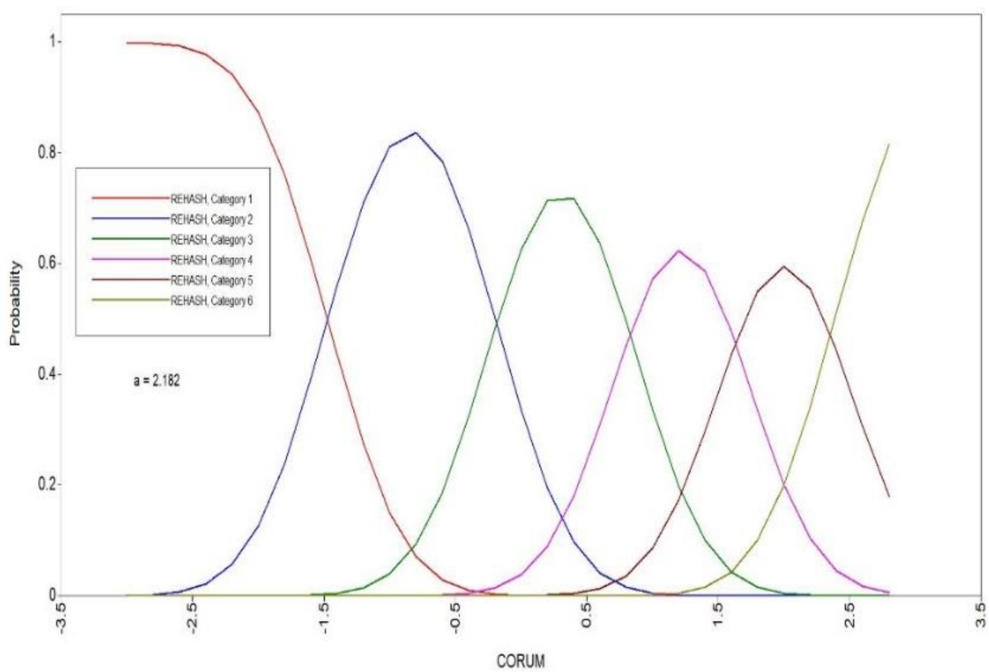
Note: (a) *"*dwelling on negative affect"



Note: (b) "mutual encouragement of problem talk"



Note: (c) "speculating about problems"



Note: (d) "rehashing problems"