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Deficits in Inhibitory Control May Place Service Members at Risk for Posttraumatic Stress Disorder and Negative Parenting Behavior Following Deployment-Related Trauma

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Abstract

This study examined the mediating role of posttraumatic stress disorder (PTSD) symptoms in the association between deployment-related trauma exposure and parenting behaviors in reserve-component military service members and whether this association was contingent upon parent inhibitory control (IC). Participants were 181 postdeployed fathers and their children. Fathers completed a neuropsychological test of IC and self-report measures of trauma exposure and PTSD symptoms. Measures of parenting behaviors (positive engagement and reactivity coercion) were obtained from direct observation of father–child interaction. Results demonstrated that (a) fathers' PTSD symptoms indirectly mediated the effect of trauma exposure on both measures of parenting (i.e., negative indirect effect for positive engagement, point estimate = $-.0045$, 95% CI [$-.0107$, $-.0003$], and positive indirect effect for reactivity coercion, point estimate = $.0061$, 95% CI [$.0007$, $.0146$]); (b) fathers' IC skills moderated the association between trauma exposure and PTSD, $\beta = .14$, $p = .043$, such that the association was positive and significant for fathers with high and medium IC but nonsignificant for fathers with low IC; and (c) the indirect effect of trauma exposure on both parenting measures through PTSD was dependent upon IC, point estimate = $.0341$, 95% CI [$.0005$, $.0687$]. These findings indicate that fathers with low IC skills tended to have higher rates of PTSD symptoms and related negative parenting behaviors, even for individuals with relatively low degrees of deployment-related trauma exposure. Results highlight the importance of IC as a potential moderating factor in the association between trauma exposure, PTSD, and parenting.

The extensive military involvement of troops in Iraq and Afghanistan over more than 15 years has resulted in increased awareness of the impact of deployment-related trauma exposure on the postdeployment health and adjustment of both service members and their families. It has been well documented that combat involvement and trauma exposure increases the risk for mental health problems in military service members (Milliken, Auchterlonie, & Hoge, 2007), including posttraumatic stress disorder (PTSD; Gewirtz, Polusny, DeGarmo, Khaylis, & Erbes, 2010; Vasterling et al., 2010). In addition, in

comparison to community samples, children with deployed parents display higher rates of internalizing behaviors (e.g., worrying and feelings of hopelessness) and externalizing behaviors (e.g., aggression and oppositional defiance) both during and after parental deployment (Gewirtz & Zamir, 2014), and the risk for these problem behaviors is greater if a parent has a diagnosis of PTSD (Davidson & Mellor, 2001; Glenn et al., 2002; Lester et al., 2010).

Although the process is not well understood, it appears that much of the negative impact of parent PTSD on child behavior occurs through the influence of PTSD on parenting. For example, among postdeployed military families, researchers have found that the association between parents' PTSD and child outcomes is mediated through the impact of parenting behaviors, including reduction in positive engagement with children (e.g., fewer displays of social responsiveness and warmth) and increased coercive behaviors (e.g., greater instances of verbal aggression and dismissive or demeaning statements or actions; Gewirtz, DeGarmo, & Zamir, 2018b; Snyder et al., 2016). Thus, a better understanding of vulnerability and protective factors that influence service members' PTSD and related parenting impairments has important implications for both individual and family wellbeing. In the current study, we examined the association between deployment-related trauma, PTSD, and parenting behaviors, with an additional focus on the role of parent inhibitory control (IC) skills. Defined as the conscious and intentional restraining or shifting of automatic responses (Cummings & Miller, 2007), deficits in IC have been identified as potential risk factor for the development of PTSD (Aupperle, Melrose, Stein, & Paulus, 2012). The present study was designed to explore whether inhibitory dysfunction in postdeployed military fathers placed these men at greater risk not only for PTSD but for impaired parenting behaviors as well.

A significant body of research has illustrated the detrimental effects of parental PTSD symptoms on multiple indices of family functioning, including parenting (Gewirtz & Zamir, 2014). Several studies have compared veterans with PTSD to veterans without the diagnosis and found that the former displayed relatively higher levels of family dysfunction. For example, Davidson and Mellor (2001) reported that Vietnam veteran fathers with PTSD struggled with communication and supportive affect in family interactions, with higher rates of overall family dysfunction in comparison to veterans without PTSD and civilian controls. Moreover, two recent reports on a National Guard/Reserves (NG/R) sample found that in veterans of the recent military operations in Iraq and Afghanistan, PTSD was associated with decreased positive engagement and increased reactivity-coercion observed during parent-child interactions, both cross-sectionally (Brockman et al., 2016) and over time (Snyder et al., 2016). These findings suggest that the hypervigilance, avoidance, and intrusive thoughts characterizing PTSD may interfere with parents' ability to provide warm, sensitive attention and inhibit harsh or negative responses to their children's behavior.

Indeed, parent PTSD may serve as an important mediator of the impact of deployment and combat experience on postdeployment family reengagement and functioning (Gewirtz & Zamir, 2014; Monson, Taft, & Fredman, 2009). A prospective study of National Guard service members deployed to recent operations in Iraq found that PTSD symptoms mediated the association between deployment injury and self-reported parenting behaviors (e.g.,

inconsistent discipline and poor supervision), with PTSD symptoms from the time of deployment to 1 year postdeployment associated with perceived parenting challenges at the second time point (Gewirtz et al., 2010).

A critical area of trauma research is the identification of individual risk and protective factors that may impact the development and/or maintenance of PTSD following exposure to traumatic events. One promising approach is to consider individual differences in neuropsychological functioning that may render individuals more or less vulnerable to the influence of trauma exposure. Executive function, defined as the set of neurocognitive processes that facilitate conscious control of thoughts, actions, and emotions, has been proposed as a potential candidate. Aupperle and colleagues (2012) theorized that deficits in executive function place individuals exposed to trauma at greater risk of developing PTSD by reducing their ability to control their cognitive responses to trauma-related stimuli, resulting in higher rates of reexperiencing and hyperarousal symptoms and subsequent increased reliance on avoidant coping techniques. This theory is supported by empirical studies demonstrating that individuals with PTSD tend to display poor performance on neuropsychological measures of executive function (Leskin & White 2007; Wu et al., 2010) and attenuated activation of prefrontal networks when completing tasks requiring executive control (Falconer et al., 2007) in comparison to individuals without PTSD.

Recent research by Degutis and colleagues (2015) suggests that the majority of the association between executive dysfunction and PTSD is due to the impact of one individual executive function: IC. After administering a battery of tasks measuring multiple components of executive function (e.g., working memory and cognitive flexibility) to postdeployment veterans, the authors found that only the measures of IC explained significant variation in PTSD symptoms. The authors proposed that IC plays a critical role in allowing veterans to disengage from or inhibit their responses to trauma-related triggers in their environment or memory, thus reducing the likelihood of developing more persistent symptoms.

It is important to note that the association between IC and PTSD is likely bidirectional. Although pretrauma inhibitory dysfunction may place individuals at risk for developing PTSD, it is also possible that PTSD symptoms impair IC. For instance, heightened arousal and reexperiencing symptoms might decrease concentration and boost reactivity, resulting in more impulsive responding. Unfortunately, longitudinal studies necessary to conclusively address this issue have not yet been performed (Aupperle et al., 2012). For the present study, we were also reliant on measures of IC collected after potential trauma exposure (i.e., following military deployment), hindering our ability to draw conclusions about directionality of effects. In an attempt to mitigate this limitation, we chose to focus upon the role of IC as a moderator in the association between deployment-related trauma exposure and PTSD, an approach that has not been taken in any previous studies. Specifically, we hypothesized that if inhibitory dysfunction is indeed a risk factor for PTSD, then individuals with poor IC skills would be at high risk for the development of PTSD even if their trauma exposure during deployment was low or mild whereas individuals with average or high IC skills would only report PTSD symptoms if they had been exposed to higher degrees of trauma. This moderation approach is further delineated in our second hypothesis (outlined

later in this section). In addition, we investigated whether this moderating role might also influence the association between trauma, PTSD, and parenting behaviors (as presented in our third hypothesis).

The purpose of the present study was to investigate the role of IC in PTSD symptoms and parenting behaviors of service members postdeployment. We used data from a larger study of military families in which a parent had been deployed to the recent conflicts in Iraq and Afghanistan, focusing specifically on a subsample of previously deployed NG/R military fathers and their families. In an earlier study with families drawn from the same (larger) sample [Brockman et al., 2016], the authors found that fathers' PTSD symptoms were associated with multiple areas of observed parenting behavior, including diminished positive engagement and increased coercive behaviors. In the present study, we build on these findings by testing the moderating role of IC among the associations of deployment-related trauma exposure, fathers' PTSD symptoms, and parenting behaviors. Our approach focused on three hypotheses.

First, we hypothesized that deployment-related trauma exposure would influence parenting behaviors indirectly through the mediating influence of PTSD symptoms. Although the association between deployment-related trauma exposure and PTSD is very well established (Smith et al., 2008) and multiple studies have indicated that PTSD may have a deleterious effect on family functioning (Gewirtz & Zamir, 2014), few studies have investigated the potential mediating role of PTSD in linking trauma exposure to parenting behavior specifically. It should be noted that Brockman et al. (2016) did not find a significant correlation (i.e., zero-order effect) between trauma exposure and parenting behaviors using a similar sample of service members and their families. However, as we propose in our third hypothesis, this lack of correlation may be due to an additional unmeasured moderating effects resulting in "indirect-only mediation."

Second, we hypothesized that fathers' IC would moderate the association between trauma exposure and PTSD symptoms. Based on Aupperle et al.'s (2012) theory that individuals with poor or deficient IC are at especially high risk for PTSD, we expected that the service members in our sample with lower IC skills would report higher rates of PTSD symptoms, regardless of degree of deployment-related trauma exposure. Specifically, we predicted that the association between trauma exposure and PTSD symptoms would be significant only for individuals with average or above-average IC skills. For individuals with poor IC skills, we predicted that PTSD symptoms would be relatively high even if the degree of trauma exposure was relatively low, meaning the association between trauma exposure and PTSD would be nonsignificant for this group.

Third, we hypothesized that fathers' IC would moderate the indirect path of trauma exposure to parenting behaviors through PTSD, consistent with a moderated mediation model (Figure 1). We predicted that this indirect pathway would be weakest for service members with poor IC skills as these individuals would be at high risk of developing PTSD and subsequent impaired parenting, regardless of degree of trauma exposure.

Method

Participants

In the current study, we report on baseline data from a randomized controlled trial of a parenting program designed for postdeployment NG/R military families in which at least one parent had been deployed in service of the recent and/or ongoing military operations in Iraq and Afghanistan ($N = 336$; Gewirtz, Pinna, Hanson, & Brockberg, 2014). Our study focused on a subset of the larger study sample, consisting of 181 male service members and their families. Although the larger sample included some female service members, the number was too small to allow for meaningful comparisons between male and female participants, leading to the decision to only include male participants in the current sample. Fathers were 37.76 years old on average ($SD = 6.42$; range: 24–58 years) and predominantly White, non-Hispanic (87.8%). The majority of the fathers were Army National Guard or Army Reservists (74.6%) with the remainder serving in the Air Guard and Navy Reserves or other military branches. The mean number of deployments was 2 ($SD = 1.13$; range: 1–8). Self-reported estimates of total time of deployment (across all deployments) indicated that 31.7% were deployed for 1 year or less, 33.9% for 1–2 years, and 34.4% for 2 years or more. On average, the time interval between the survey date and the last returning date as indicated by the participant was 913 days. The majority (89.5%) of the fathers reported being married. Most families had two (44.2%) or three (29.8%) children living in their households (range: 1–5). In multichild families, the oldest child within the eligible range (ages 4–12 years) was chosen as the target child (this decision was based on the requirements of the larger intervention study). A little over half (53.0%) of the target children were female (age $M = 8.43$ years, $SD = 2.44$).

Procedure

All study procedures were reviewed and approved by the University of Minnesota IRB. Postdeployment military families were recruited through media advertisements, referral from military affiliated personnel, military events, and word-of-mouth. Interested families were screened for eligibility and consented to participate in the study if they met the following criteria: (a) at least one parent had deployed to the recent military operations in Iraq and Afghanistan, (b) at least one child between the ages of 4 and 12 years was living in the home, and (c) they were willing to be randomized into an intervention program or control condition (the current study does not report data related to the intervention; see Gewirtz, DeGarmo, & Zamir, 2018a). Parents completed self-report questionnaires online (data from nonmilitary parents were not included in this study). Parent(s) and the target child were then administered an approximately 3-hr in-home assessment, which included a measure of IC and a set of family interaction tasks.

Measures

Trauma exposure.—The Deployment Risk and Resilience Inventory (DRRI; King et al., 2006) is a measure of combat-related trauma exposure with well-established internal reliability and validity. The scale includes two 15-item subscales that assess experience both during combat (e.g., participating in combat patrols) and following combat (e.g., observing or handling human remains; Cronbach's $\alpha s = .88$ and $.91$, respectively). Scores of the two

subscales were summed to create a composite score with higher scores indicating greater degrees of combat-related trauma exposure.

PTSD symptoms.—The military version of the Posttraumatic Stress Disorder Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to assess posttraumatic symptoms related to military experience. This widely used scale has shown good internal reliability and validity in previous research (Wilkins, Lang, & Norman, 2011). Respondents were asked to rate 17 items on a 5-point scale, with each item indicating the severity of symptoms. A composite score was calculated by summing up all items (Cronbach's $\alpha = .93$).

Inhibitory control.—Inhibitory control was measured using a computer administered Go-NoGo task (Braver, Barch, Gray, Molfese, & Snyder, 2001). Participants were presented with series of stimulus letters which appeared on screen for 250 ms, with an interstimulus interval of 1000 ms. They were instructed to press a button each time a letter flashed on the screen (the “Go” condition), with an exception for the letter “X,” when they were asked to refrain from pressing the button (the “NoGo” condition). Participants were presented with 165 letters in total, 33 of which were the letter X. Scores were based on the number of commission errors (i.e., when the participant hit the button in response to an X). Final scores were reverse coded for ease of interpretation, so that higher scores indicated fewer performance errors (i.e., better IC).

Parenting behaviors.—Fathers were each asked to identify an area of frequent family conflict, such as disagreements surrounding household chores, as well an area of concern related to their past or future deployments, such as missing family events. Assessment technicians presented the fathers with a list of issues and asked them rate the degree to which the issue had been a “hot topic” (i.e., a source of conflict) in the family in the past 2 weeks. The fathers were assisted in selecting the “hottest” topic for the dyad to discuss. The dyads were then asked to discuss each topic for a period of 5 min each. The discussions were videotaped and rated using the Macro-Level Family Interaction Coding Systems (MFICS; Snyder, 2013). Previous reports have documented the reliability and validity of this coding system (Brockman et al., 2016; Snyder et al., 2016). The MFICS includes 55 items rated on a 5-point scale. The current study focused on the categories of positive engagement and reactivity-coercion. We chose to focus on these particular categories as they are consistent with two key components of effective parenting: a high degree of positive, sensitive interaction and a low degree of negative, coercive behaviors (Patterson & Fisher, 2002). Behaviors coded as positive engagement included showing interest, being attentive, and validating the child's distress or negative affect. Behaviors coded as reactivity-coercion included attempts to control or dominate the conversation, displays of impatience, and dismissing or deriding the child's emotional displays. Four coders were trained to an item-level reliability kappa value greater than .70 on 35-min samples of videotaped family interactions. Reliability was assessed for 25% of the family video samples, and the average intraclass correlations for male service members were .71 for the Positive Engagement subscale and .47 for the Reactivity-Coercion subscale.

Data Analyses

We performed data analyses using SPSS (Version 23; IBM Corp., 2015). Data were imputed for 29 participants on core analyses using a hot deck imputation procedure, facilitated by an SPSS Macro created by Myers (2011). Hot deck imputation was utilized due to its compatibility with the Hayes (2013) SPSS Macro. The validity of the technique is comparable to multiple imputation (Roth, 1994). Analyses of missingness confirmed that the data met Missing at Random assumptions necessary for hot deck imputation (Roth, 1994). Bivariate correlations were tested using Pearson correlation analysis. Further analysis progressed in three steps, based on the recommendation of Hayes (2013) and facilitated by his SPSS Macro. First, we conducted a pair of simple mediation analyses, which included assessing the effects of deployment-related trauma on the two parenting outcomes (positive engagement and reactivity-coercion), both directly and indirectly through PTSD symptoms. Second, we assessed the extent to which the effect of trauma exposure on PTSD symptoms was moderated by IC using moderated ordinary-least squares (OLS) regression analysis. The final step was a set of moderated-mediation analyses, which estimated the conditional indirect effects of trauma on parenting behavior through PTSD symptoms as a function of IC. Simple mediation and moderated-mediation analyses included the covariates child age, child gender, and fathers' education level, based on their potential to influence parenting behavior. Education level was included as a covariate in the moderated OLS regression analysis to ensure it did not confound the relationship between IC and PTSD.

Results

Descriptive Characteristics and Bivariate Correlations

Means and standard deviations for all study variables are presented in Table 1. Mean total trauma exposure scores were roughly comparable with those reported in studies of larger samples of deployed NG/R service members (King et al., 2006). The mean PCL-M score for PTSD symptoms was 28.7 ($SD = 10.8$; range: 17–71), with 11.1% of participants meeting clinical criteria for PTSD, based on the symptom-clustering method created by Hoge et al. (2004).

Correlations between the observed variables are also displayed in Table 1. Trauma exposure was not significantly correlated with positive engagement or reactivity-coercion, suggesting that any association between trauma and parenting behaviors would be indirect in nature. Trauma exposure was positively correlated with PTSD symptoms whereas correlations between trauma exposure and measures of parenting behaviors went in expected directions (negative for positive engagement and positive for reactivity-coercion) but were not significant. Posttraumatic stress disorders symptoms were negatively correlated with positive engagement and positively correlated with reactivity-coercion. Additionally, PTSD symptoms were negatively correlated with IC, suggesting that individuals with lower IC skills had higher levels of PTSD symptoms.

Simple Mediation Analysis

Using the PROCESS macro for SPSS (Hayes, 2013), the following models were used to derive the total, direct, and indirect effects of trauma exposure on parenting behaviors

(positive engagement and reactivity-coercion) through PTSD symptom, using OLS regression (covariates included child age and gender and fathers' education level):

$$\text{Positive Engagement/Reactivity-Coercion} = \text{constant} + c(\text{trauma exposure}) + \text{covariates} + \text{error} \quad (\text{Equation 1})$$

$$\text{PTSD Symptoms} = \text{constant} + a(\text{trauma exposure}) + \text{covariates} + \text{error} \quad (\text{Equation 2})$$

$$\text{Positive Engagement/Reactivity-Coercion} = \text{constant} + c'(\text{trauma exposure}) + b(\text{PTSD symptoms}) + \text{covariates} + \text{error} \quad (\text{Equation 3})$$

As can be seen in Models 1 and 3 in Table 2, results for Equation 1 suggest that trauma exposure was not significantly associated with positive engagement or reactivity-coercion. Results for Equation 2, shown in Model 5 in Table 2, suggest that individuals with more trauma exposure reported higher rates of PTSD symptoms. Symptoms of PTSD were negatively related to positive engagement and positively related to reactivity-coercion (see Table 2, Models 2 and 4).

We addressed our first hypothesis (that deployment-related trauma exposure would impact parenting behaviors indirectly through the mediating influence of PTSD symptoms) by examining the indirect effect of trauma exposure on the parenting behaviors outcome variables (i.e., positive engagement and reactivity-coercion) quantified as the product of the regression coefficient estimating PTSD symptoms from trauma exposure and the regression coefficient estimating parenting behaviors from PTSD controlling for trauma exposure (as presented in Equation 3). A bias-corrected bootstrap-confidence interval for the product of these paths that does not include zero provides evidence of a significant indirect effect of trauma exposure on parenting behaviors through PTSD symptoms. Using the PROCESS procedure with 5,000 samples revealed a significant negative indirect effect of trauma exposure on positive engagement through PTSD symptoms, point estimate = -.0045, 95% CI [-.0107, -.0003], and a significant positive indirect effect of trauma exposure on reactivity-coercion through PTSD symptoms, point estimate = .0061, 95% CI [.0007, .0146].

Moderation of the Effect of Trauma Exposure on PTSD Symptoms by IC

To address our second hypothesis (fathers' IC would moderate the association between trauma exposure and PTSD symptoms), we tested for the effect of trauma exposure on PTSD symptoms by IC by estimating an OLS regression model predicting PTSD symptoms from trauma exposure, IC (i.e., Go-NoGo performance), and their product (parent education level was included as a covariate):

$$\text{PTSD Symptoms} = \text{constant} + a_1(\text{trauma exposure}) + a_2(\text{IC}) + a_3(\text{Trauma Exposure} \times \text{IC}) + \text{covariates} + \text{error} \quad (\text{Equation 4})$$

This analysis revealed that the effect of trauma exposure on PTSD symptoms was dependent on IC (Model 5 in Table 2). To further explore the nature of this interaction, simple regression lines were computed for the association between trauma exposure and PTSD symptoms at specific values of IC, measured using Go-NoGo performance (low = 1 standard deviation below the mean, a score of 14.27 or lower; medium = within 1 standard deviation from the mean score of 20.49 (between 14.27 and 26.71); high = 1 standard deviation above the mean, score of 26.71 or higher). As illustrated in Figure 2, the association between trauma exposure and PTSD symptoms was significant for fathers with high and medium IC skills, $B = 0.68$, $p < .001$ and $B = 0.48$, $p < .001$, respectively. However, the association between the two variables was just outside the bounds of significance for fathers with IC scores less than one standard deviation below the mean, $B = 0.25$, $p = .063$. Further analysis using the Johnson-Neyman technique revealed that the association between the two variables transitioned from significant to nonsignificant at a Go-NoGo score of 15.06, meaning the trauma exposure was not significantly associated with PTSD symptoms for individuals with IC skills more than one standard deviation below the mean for this sample. The visualization provided by Figure 2 suggests that this lack of an association was due to fathers with poor IC skills reporting high rates of PTSD symptoms, independent of degree of trauma exposure.

Moderated Mediation Analysis

Previous analyses provided evidence of a negative indirect effect of trauma exposure on positive engagement and reactivity-coercion through PTSD symptom (simple mediation, as proposed in our first hypothesis) and a moderating effect of IC on the association between trauma exposure and PTSD (as proposed in our second hypothesis). These findings were supportive of a moderated mediation effect (proposed in our third hypothesis and presented in Figure 1), in which the indirect effect of trauma exposure on parenting behaviors through PTSD is dependent upon IC. To confirm a moderated mediation model, we followed the procedure recommended by Hayes (2013) for estimating a conditional indirect effect. This approach combines the estimates from the simple mediation analysis (Equation 3) and the moderation analysis (Equation 4) so that the conditional indirect effect of trauma exposure on parenting behaviors through PTSD symptoms is the product of the effect of trauma exposure on parenting behaviors controlling for PTSD symptoms (b in Equation 3) and the conditional effect of trauma exposure on PTSD symptoms as a function of IC ($a_1 + a_3IC$ from Equation 4). Using the PROCESS procedure with 5,000 samples revealed a significant conditional indirect effect, point estimate = .0341, 95% CI [.0005, .0687]. We used 5,000 bootstrap estimates for the construction of 95% bias-corrected confidence intervals for three levels of IC. Specifically, we used the mean as well as one standard deviation above and below the mean for Go-NoGo scores to represent medium, high, and low levels of IC performance.

Table 3 contains the point estimates and 95% CIs for the conditional indirect effects. The indirect effect of trauma exposure on positive engagement through PTSD symptoms was negative and significant among individuals with high and average IC skills; trauma exposure was associated with higher levels of PTSD symptoms, which in turn were associated with lower rates of positive engagement. However, this indirect effect was not significantly different from zero among those with low IC skills. Results for reactivity-coercion followed

a similar pattern. Once again, the indirect effect of trauma exposure on reactivity-coercion was significant among participants with high and average IC but nonsignificant for those with low abilities. Combined, these results suggest that individuals with poor IC skills tended to have high rates of PTSD symptoms and related parenting difficulties, regardless of degree of deployment-related trauma exposure.

Discussion

Analyses revealed three key findings. First, greater trauma exposure was associated with higher levels of PTSD symptoms which in turn were associated with lower observed positive engagement and greater observed reactivity-coercion (i.e., an indirect effect from trauma exposure to parenting behaviors). The second key finding revealed that the association between trauma exposure and PTSD symptoms appears to be moderated by IC such that the expected dose–response relationship between trauma and PTSD only holds for individuals with moderate to high levels of IC. Fathers with low IC had high rates of PTSD symptoms, regardless of the degree of deployment trauma exposure. Finally, the indirect effect of trauma exposure on parenting behaviors was dependent on IC; that is, the effect held only for fathers with moderate-to-high IC. Fathers with poor IC had higher rates of PTSD symptoms and related negative parenting behaviors regardless of their amount of trauma exposure.

Our first key finding is consistent with those reported in earlier studies indicating that exposure to traumatic events impairs parenting via the impact of PTSD symptoms; that is, PTSD symptoms appear to be the more proximal influence on parenting behaviors. The body of literature documenting the impact of PTSD on parenting among both military and civilian populations is relatively well established (e.g., Creech & Misca, 2017) but few studies have included measurement of military or battle stressors. Although we did not include child outcomes in this study, we have previously documented associations, both concurrently and longitudinally, between parenting impairments and a wide range of child adjustment issues, including increased behavior problems and decreased adaptive coping skills (Gewirtz, DeGarmo, & Zamir, 2018b, 2018a). Moreover, Synder et al. (2016) used the same sample and measures used in the current study to document reciprocal cascades over a 2-year period between fathers' and mothers' PTSD symptoms and children's internalizing and externalizing symptoms. Further research should extend these findings by investigating the longitudinal pathways from exposure to traumatic events, PTSD, impairments in parenting, and child maladjustment.

The current study was the first of which we are aware to establish IC as a moderator in the association between trauma exposure and PTSD, providing some support for the proposal that deficits in IC may be a risk factor for the development of PTSD (Aupperle et al., 2012). Whereas prior studies have revealed IC as a correlate of PTSD (e.g., Degutis et al., 2015), the present study not only replicated this finding but also demonstrated that individuals with poor IC had a relatively high number of PTSD symptoms even with relatively low rates of trauma exposure, supporting the hypothesized role of IC as a risk factor for PTSD. Further research is needed to examine these factors as they unfold over time. Although it is considered relatively stable in adulthood, there is evidence that interventions can boost IC

and executive function. For example, mindfulness training in particular and attentional training in general have been shown to be effective in improving executive functioning in service members as well as in civilians (e.g., Chiesa, Calati, & Serretti, 2011; Rabipour & Raz, 2012). It may also be possible to target poor IC as a component in the treatment of PTSD for some individuals, in line with a personalized treatment approach (Collins & Varmus, 2015). For example, screening individuals with PTSD for IC impairments and then tailoring PTSD treatment accordingly may be a cost- and time-efficient strategy to address both PTSD symptoms and underlying IC impairments. Screening for IC screening may also be helpful in making decisions about the suitability of individuals who will experience high operational tempos and intense battle conditions (e.g., Special Operations personnel) along with other “fitness for duty” assessments (Monahan & Keener, 2012).

The third key finding of this study indicated that the meditational association between trauma exposure, PTSD symptoms, and parenting impairments was moderated by IC; that is, regardless of deployment-related trauma exposure, individuals with poor IC skills tended to have high rates of PTSD symptoms and related parenting behaviors, specifically reduced instances of positive engagement and increased instances of reactivity coercion. This finding is important because it suggests deficits in IC may not only place individual service members at risk for PTSD but also place their children at risk for experiencing suboptimal parenting, leading to increased risk for child behavioral and emotional problems. In stressful family contexts, such as the experience of a parent’s deployment, effective parenting is particularly crucial and, unfortunately, at risk (Gewirtz & Zamir, 2014). Thus, interventions to strengthen parenting in these contexts provide a valuable opportunity to interrupt a potentially toxic mix of family stress, deficits in parenting related (or unrelated) to IC, and resultant risks to child adjustment (e.g., Gewirtz et al., 2018a).

Together, our findings suggest that a potential line of research might focus on interventions addressing poor IC not simply for PTSD interventions but, more broadly, for interventions to improve parenting and family functioning. As prior research has indicated that IC is malleable, even in adulthood, it seems worthwhile to consider incorporating attentional strategies, such as mindfulness exercises, not only in individual interventions (e.g., for PTSD) but also in family-based interventions, such as parenting programs for postdeployment military families (e.g., Zhang, Rudi, Zamir, & Gewirtz, 2017).

The key limitation of this study was its reliance on concurrent measurement of PTSD symptoms, parenting behaviors, and IC, which prevents any conclusions regarding the directionality of associations. As noted earlier, prior studies have confirmed longitudinal associations between parental PTSD, parenting behaviors, and child adjustment (e.g., Snyder et al., 2016). The issue of directionality in the association between IC and PTSD is more problematic and is emblematic of limitations in the broader literature; at this time, we are not aware of any studies that have measured IC or any other form of executive function prior to trauma exposure. Although other forms of research, such as studies of twins discordant for trauma exposure (Gilbertson et al., 2006), do provide some evidence supportive of the role of deficits in IC as a risk factor for PTSD, future longitudinal studies are critical to confirm this supposition. An additional limitation of this study and the wider literature is the lack of measures of trauma exposure occurring prior to deployment, which previous studies

have identified as an important risk factor for deficits in IC and other areas of executive function (Nikulina & Widom, 2013) as well as PTSD (King, King, Foy, & Gudanowski, 1996). Future research should include repeated measures (pre- and postdeployment) of trauma, executive function, PTSD symptoms, and parenting to parse out the direction of effects.

Additional limitations include the use of a single measure of IC. Although authors of a previous study (Degutis et al., 2015) suggested that IC is the critical executive function subdomain associated with PTSD symptoms, it is possible that additional executive functions, such as working memory or set-shifting, might play a moderating role in the association between deployment-related trauma and PTSD symptoms. It should also be noted that parenting behaviors were assessed using observations of conflict and emotion-laden tasks (i.e., problem-solving an area of family conflict and a deployment stressor). It is possible that PTSD symptoms are differentially associated with parenting behaviors in less stressful situations, such as play, and nonconflict discussion; this is an arena for further investigation.

The current sample was limited to a Reserve Component population with a relatively modest level of PTSD symptoms (e.g., just 11% met clinical criteria for PTSD). Thus, results may not generalize to active-duty populations or to military populations with higher levels of PTSD symptoms. Replicating these results in civilian populations with PTSD symptoms is also an important area for future research. Finally, we focused on male service members only because only a small minority of mothers in this sample had been deployed. Future research is warranted to examine IC and parenting behaviors among female deployed service members, especially given the results from a recent meta-analysis suggesting that women are more likely to experience PTSD symptoms following combat than men (Xue et al., 2015).

Despite its limitations, the study was the first to illuminate the importance of IC in the associations between deployment-related combat exposure, PTSD symptoms, and parenting behaviors. We used multiple methods (objective assessment of IC, self-report of PTSD symptoms, and observational measures of parenting behaviors) to understand these associations among an understudied sample of fathers exposed to wartime deployments. The study provides preliminary data to suggest that attending to IC in this population may assist in magnifying the impact of interventions for both service member and family functioning.

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Figure 1.
Conceptual model. PTSD = posttraumatic stress syndrome.

Figure 2.

The association between trauma exposure and posttraumatic stress disorder (PTSD) symptoms moderated by level of inhibitory control. Trauma Exposure = severity of combat-related trauma exposure as measured by the Deployment Risk and Resilience Inventory; PTSD Symptoms = severity of PTSD symptoms as measure by the Posttraumatic Stress Disorder Checklist; Inhibitory Control = inhibitory control skills measured using a Go-NoGo task; higher scores indicate better performance.

Table 1:

Descriptive Statistics and Bivariate Correlations Between All Variables

	1	2	3	4	5	6	7	8
1. Child age (years)	-	-.02	.02	.12	.04	.13	-.13	-.03
2. Child gender (male) ^a		-	-.03	-.09	-.12	.13	-.01	.08
3. Fathers' education ^b			-	.04	-.11	.15	.16 [*]	-.08
4. Trauma exposure				-	.34 ^{**}	.07	-.10	.05
5. PTSD symptoms					-	-.19 [*]	-.21 ^{**}	.16 [*]
6. Inhibitory control						-	-.04	-.01
7. Positive engagement							-	-.46 ^{**}
8. Reactivity-Coercion								-
<i>M</i>	8.43	47.0%	47.8%	9.07	28.68	20.82	3.52	0
<i>SD</i>	2.44	~	~	7.58	10.84	5.89	.57	.83

Note. *N* = 184.

^aChild gender: male = 1; female = 2. Percentage (47.0%, shown in *M* row) is for male children.

^bFathers' education: Generalized equivalency diploma (GED) = 2; high school = 3; some college = 4; associate's degree = 5; college degree = 6; master's degree = 7; doctoral or professional degree = 8. Percentage (47.8%, shown in *M* row) refers to associate's degree or higher.

^{*}*p* < .05.

^{**}*p* < .01.

Table 2:

Ordinary Least Squares Regression Model Coefficients

Outcome	Positive Engagement			Reactivity-Coercion			PTSD Symptoms		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Predictor	β	SE	β	SE	β	SE	β	SE	β
Child age	-.13	.02	-.13	.02	-.03	.03	-.02	.03	
Child gender	-.02	.08	-.03	.08	.08	.13	.09	.12	
Fathers' education	.16*	.03	.14	.03	-.08	.05	-.06	.05	-.12
Trauma exposure	-.09	.01	-.03	.01	.07	.01	.01	.01	.34**
PTSD symptoms									.10
IC			-.18*	.00		.16*	.01		
									-.14**
Trauma $\times$ IC									.14*
Model R^2	.05		.08*		.02		.04		.18**
Interaction R^2									.02*

Note. PTSD = posttraumatic stress disorder; IC = inhibitory control.

* $p < .05$.

** $p < .01$.

Conditional Indirect Effects of Deployment-Related Trauma Exposure on Parenting Behaviors Through Posttraumatic Stress Disorder (PTSD) Symptoms at Levels of Inhibitory Control

Table 3:

Inhibitory Control		Positive Engagement		Reactivity-Coercion	
		Point estimate	95% CI	Point estimate	95% CI
High	(26.71)	-.0062 ^a	[-.0160, -.0004]	.0084 ^a	[.0015, .0214]
Medium	(20.49)	-.0044 ^a	[-.0105, -.0003]	.0059 ^a	[.0007, .0140]
Low	(14.27)	-.0025	[-.0088, .0004]	.0034	[-.0006, .0122]

Note.

^aSignificant effect (95% CI does not include 0)