

Inhibitory Control Moderates the Intervention Effects of a Preventive Parenting Program on Posttraumatic Stress Disorder Symptoms Among Male Service Members

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Military servicemembers face substantial challenges due to war-related trauma exposure, including posttraumatic stress disorder (PTSD). Individuals with deficits in inhibitory control (IC) may have an increased risk of developing PTSD due to a reduced ability to regulate their cognitive responses to and disengage from trauma-related stimuli. After Deployment, Adaptive Parenting Tools (ADAPT) is a mindfulness-infused parenting program for military families that has also been found to have crossover effects on parental mental health. The present study examined whether fathers' IC at baseline affected their response to this emotional skills-focused intervention and further influenced their PTSD symptoms 1 year later. The sample included 282 male National Guard and Reserve (NG/R) service members who had recently been deployed to Iraq or Afghanistan. Fathers were randomly assigned to either the ADAPT program or a control condition, with IC measured at baseline and PTSD symptoms measured at baseline and 1-year follow-up. Intent-to-treat analyses revealed no significant main effect of the intervention on fathers' PTSD symptoms. However, fathers' IC moderated intervention effects on PTSD symptoms, $f^2 = 0.03$. The intervention had more beneficial effects on reducing fathers' PTSD symptoms for participants with low IC at baseline. These findings are consistent with compensatory effects in the risk moderation hypothesis, which suggests that prevention or intervention programs are more effective for high-risk subgroups.

Nearly 3,000,000 members of the United States military have been deployed in Iraq and Afghanistan since the start of combat operations following the September 11, 2001, terrorist attacks (U.S. Department of Defense, 2019). Combat experiences and war zone exposure can result in substantial psychological and emotional stress for military service members. Research on the “invisible wounds” of war has highlighted the impact of posttraumatic stress disorder (PTSD) on military service members (Tanielian et al., 2008). PTSD can develop after a serious threat to an individual's life or bodily integrity (e.g., combat) and is characterized by heightened arousal or emotional numbing, at-

tempts to avoid stimuli that bring on distressing memories, and the reexperiencing of traumatic events (American Psychiatric Association [APA], 2013). The disorder often co-occurs with major depression, substance abuse, and other mental health problems (Dedert et al., 2009). Findings from studies examining the prevalence of PTSD among military service members have suggested that about 20% of Iraq and Afghanistan veterans meet the diagnostic criteria for PTSD (Milliken et al., 2007; Seal et al., 2009).

Research in samples of combat veterans has documented an association between war-related posttraumatic stress symptoms and parenting impairments following deployment (Paris et al., 2010). For example, among male National Guard soldiers, Gewirtz et al. (2010) found that increases in PTSD symptoms were associated with poorer self-reported parenting behaviors 1 year following the return from deployment. In a sample of National Guard and Reserve (NG/R) veterans, Brockman et al. (2017) found that participants' PTSD symptoms were negatively associated with their observed engagement with their children during parent-child interactions; PTSD symptoms were also linked to withdrawal and avoidant behaviors toward their children. Therefore, PTSD symptoms in military parents appear to impair effective parenting.

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Parenting is malleable, and parenting programs may benefit trauma-exposed individuals who struggle with parenting difficulties. After Deployment, Adaptive Parenting Tools (ADAPT; Gewirtz et al., 2018) is a parenting intervention for postdeployed military parents. Based on the social interaction learning theory (Patterson, 2005), ADAPT is a modification of the Parent Management Training–Oregon model (PMTO; Forgatch & Patterson, 2010), which focuses on five core components of effective parenting behaviors: problem solving, constructive discipline, positive involvement, skill encouragement, and monitoring. In addition to these five components, ADAPT includes two additional components—emotion socialization and mindfulness—to enhance parents’ ability to coach their children’s emotions and their emotion regulation. These two skills were added to the original PMTO model due to the body of literature showing that improving parents’ capacity to manage their own emotions and constructively respond to children’s emotions is key to addressing children’s adjustment problems (Katz et al., 2012). Emotion socialization is also theoretically congruent with the social interaction learning model.

Parenting programs can not only improve parenting practices but also reduce parents’ mental health symptoms. Previous studies of ADAPT have demonstrated that the program is effective in reducing parents’ psychological distress (i.e., PTSD and depression) by improving emotion regulation and parenting efficacy. Specifically, mindfulness exercises, such as body scans and breath exercises, were incorporated into all sessions to foster parents’ emotion regulation by enhancing their nonjudgmental awareness and acceptance of their emotions and thoughts. Parents were encouraged to notice, observe, and let their emotions and thoughts go rather than unconsciously or impulsively reacting to distressing emotions via avoidance or suppression (i.e., enhanced emotion regulation abilities; Crane et al., 2017). These mindfulness exercises may reduce parents’ PTSD symptoms (King et al., 2013). In other PMTO studies that did not integrate mindfulness exercises or emotion coaching, participation in the intervention was also found to improve parental mental health and functioning (Akin et al., 2018; Solholm et al., 2019). Teaching parenting strategies and techniques may provide parents with effective tools to respond to stressful situations, such as interactions with their children. Increased parental involvement and a sense of control may further translate to decreased emotional distress and PTSD symptoms. However, previous studies have only demonstrated a direct effect of ADAPT on parental psychological distress in mothers, most of whom have been civilian participants. The lack of effect in fathers may be because a predominantly higher percentage of fathers in the study sample have been deployed and reported higher levels of PTSD symptoms—15.2% of fathers were above the clinical cutoff for PTSD compared to 6% of mothers in the sample. Indeed, Chesmore et al. (2018) found that PTSD symptoms moderated fathers’ responses to the ADAPT intervention such that fathers whose self-reported symptoms met or exceeded the clinical threshold for PTSD did not show benefit from ADAPT on observed parenting prac-

tices compared to those who scored below the clinical cutoff. Therefore, not all fathers respond to the ADAPT intervention by reporting decreases in psychological distress (e.g., PTSD), and fathers’ PTSD symptoms may inhibit their benefit from parenting interventions.

Considering individual differences in neuropsychological factors may shed light on the field’s understanding of participants’ responses to intervention. An emerging body of literature has recognized the link between PTSD and cognitive functioning, such as executive function (Esterman et al., 2019). Executive function, primarily controlled by the prefrontal cortex, allows for a wide range of goal-oriented behaviors, including sustained attention, working memory, inhibitory control, flexibility, and planning (Alvarez & Emory, 2006). Individuals with traumatic experiences or posttraumatic stress symptoms may exhibit compromised executive function (Aupperle et al., 2012). For example, in a sample of Dutch veterans, participants with PTSD displayed more deficits in memory and learning compared with their counterparts without PTSD (Geuze et al., 2009). Findings from another study showed that sustained attention was negatively related to PTSD severity among survivors of a major disaster in the Netherlands (Meewisse et al., 2005).

Deficits in inhibitory control, such as difficulties in stopping or switching automatic responses or difficulties in controlling selective attention, have been consistently reported in participants with PTSD (for a review, see Jak et al., 2016). In a recent study, veterans with PTSD symptoms were administered a broad battery of executive function tasks, including measures of inhibitory control, working memory, and task switching. Inhibitory control was found to be particularly impaired in participants with PTSD and depressive symptoms (DeGutis et al., 2015). These findings indicate that individuals with symptoms of PTSD may have difficulty disengaging attention from trauma-related distractors (i.e., distractor suppression) and inhibiting automatic response patterns (i.e., response inhibition). These cognitive impairments are closely related to the reexperiencing and hyperarousal symptoms of PTSD. Evidence from neurobiological research has also revealed that veterans with PTSD symptoms display reduced right inferior frontal gyrus response, which is associated with inhibitory control in both emotional and nonemotional contexts (Van Rooij et al., 2015). Given the robust association between inhibitory control and PTSD symptoms, the present study primarily focused on inhibitory control, rather than executive function, and its relation to PTSD symptoms among postdeployed military service members.

Pretrauma inhibitory control deficits can be a risk factor for the development of PTSD symptoms. Marx et al. (2009) measured predeployment neurocognitive performance, including memory, executive attention, inhibitory control, in a sample of deployed soldiers and assessed their PTSD symptoms both pre- and postdeployment. The researchers found that pretrauma memory performance was associated with posttrauma PTSD, after controlling for predeployment PTSD symptoms

and combat experiences. Aupperle and colleagues (2012) reviewed a substantial body of literature on executive function and PTSD and proposed that subtle impairments in attentional and inhibitory functions can serve as preexisting risk factors for the development and maintenance of PTSD. When individuals fail to inhibit their attention and responses, they may rely on alternative coping strategies, such as avoidance and emotional numbing, to prevent attending to traumatic memories and unwanted feelings. Individuals suffering from PTSD symptoms commonly use these strategies, which may render individuals at risk for PTSD. In an earlier study of fathers drawn from the same sample as the current study, Monn et al. (2018) found that service members with poor inhibitory control skills were more likely to exhibit PTSD symptoms regardless of their degree of combat-related trauma exposure, whereas individuals with average or above-average inhibitory control only reported PTSD symptoms if they were exposed to high degrees of trauma. This finding is consistent with the assertions of Aupperle et al. (2012) that low inhibitory control serves as a risk factor for the development of PTSD symptoms.

To our knowledge, no prior studies have examined the role of inhibitory control on amplifying or lessening the crossover effects of parenting interventions on parental PTSD symptoms; thus, we sought to examine this question in a sample of deployed fathers who had been exposed to war-related trauma. ADAPT has been shown to have a direct effect on reducing mothers' PTSD symptoms (DeGarmo & Gewirtz, 2018) as well as an indirect effect through parenting efficacy and emotion regulation on both mothers' and fathers' PTSD symptoms (Gewirtz et al., 2016); however, the direct intervention effect has not been found in fathers. This may be due to additional unmeasured moderating effects resulting in "indirect-only mediation," or a lack of direct intervention effect, a possibility that was further explored in the present study. Specifically, individuals with poorer inhibitory control may be less engaged in intervention programs and, therefore, demonstrate less benefit compared with those with better inhibitory control (i.e., leveraging effects; Crocker et al., 2018). Conversely, individuals with poorer inhibitory control may also show more positive outcomes because targeted prevention and intervention programs can be especially beneficial for those with higher levels of risk (i.e., compensatory effects; Shelleby & Shaw, 2014). Testing the risk moderation effect, which provides information about for whom the intervention works, may further inform intervention tailoring. Because male service members are disproportionately more likely to experience combat exposure and, subsequently, have a higher risk of developing PTSD symptoms than their female counterparts, as well as a lack of evidence for a direct intervention effect of ADAPT on PTSD symptoms, the current study examined risk moderation effects on the deployed fathers only.

The current study aimed to investigate the role of inhibitory control as a moderator of the "crossover effect" of ADAPT on reducing deployed fathers' PTSD symptoms. We sought to examine whether deployed fathers' inhibitory control would boost

or dampen the intervention effects of ADAPT on deployed fathers' PTSD symptoms. Due to inconsistent prior findings, we tested two contrasting hypotheses regarding the direction of the moderation effect. We examined whether (a) individuals with poorer inhibitory control at baseline would show more PTSD symptom reduction postintervention as compared with individuals with higher inhibitory control or (b) individuals with higher levels of inhibitory control at baseline would show more PTSD symptom reduction postintervention as compared with individuals with poorer inhibitory control.

Method

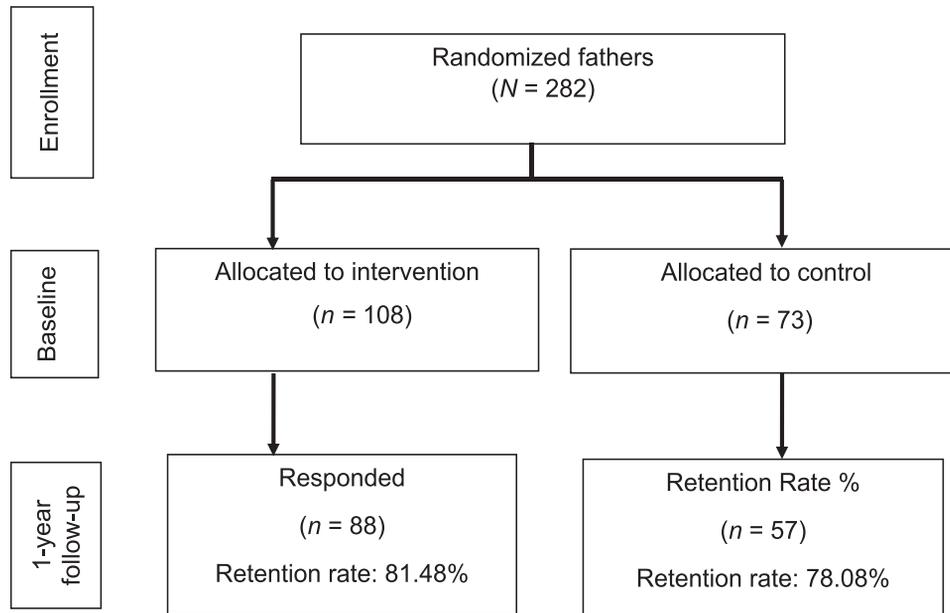
Participants

The present study used a subset of data from the ADAPT study of 336 families who were eligible to participate if the family had at least one child between 4 and 13 years of age living in the same household and at least one parent who had been deployed to the recent conflicts in Iraq and Afghanistan. The current subsample included all 282 male NG/R service members who were deployed in support of recent combat operations in Iraq and Afghanistan (U.S. Department of Defense, 2019); the remaining families in the full sample were either single-mother families or included fathers who had not been deployed. Service member participants were, on average, 37.73 years old ($SD = 6.62$, range: 23–59 years), primarily White and non-Hispanic (87.8%); 48.0% had at least a college degree. Most participants (68.4%) reported an annual family income above \$60,000 (USD) and 91.8% were married, with an average marriage length of 8.73 years ($SD = 5.91$, range: 0–28). The majority of the service members were in the Army National Guard (60.3%), and the remainder were in the Army Reserve (12.4%), Air National Guard (9.9%), Navy Reserve (3.5%), Air Force Reserve (3.2%), other branches (10.3%), or their branch was unknown (0.4%). The number of times the service members had been deployed since 2001 ranged from one to 10 ($M = 1.96$, $SD = 1.14$). The total number of months deployed across all deployments ranged from less than 6 months to more than 37 months, averaging approximately 17 months total. The average time interval from the date the participant returned from their most recent deployment and baseline data collection was 2.65 years ($SD = 2.41$, range: 0.03–9.85 years). Target children were, on average, 8.50 years old ($SD = 2.56$, range: 4.06–13.86 years), and the average number of children living in the household was 2.39.

Procedure

Recruitment took place through presentations at mandatory predeployment and reintegration events for NG/R personnel. In addition, the Minneapolis Veterans Affairs (VA) medical center mailed invitations to participate to all veterans deployed in support of the recent combat operations, flyers were posted throughout the Minneapolis/St. Paul area, there was

Figure 1
CONSORT Diagram of the Current Study



coverage through media and social media platforms, and some participants were recruited through fellow military parents and stakeholder groups. When families expressed an interest in participating in the study, they were directed to an online eligibility screening tool, followed by informed consent and an initial online assessment. The next step involved research staff conducting a baseline assessment that involved the parent or parents and target child. Following this assessment, 40% of families were randomized to a services-as-usual condition, and 60% of families were randomized to the intervention condition; this resulted in 174 fathers in the intervention group and 108 fathers in the control group. One year after the baseline assessment and approximately 6 months after the end of the intervention, participants completed another assessment. The overall retention rate was 77.3% at the 1-year follow-up, and there was no significant difference in retention rates for the intervention group (78.2%, $n = 136$) and the control group (75.9%, $n = 82$). All procedures were approved by the Institutional Review Board of the University of Minnesota.

ADAPT is a parenting intervention for military families that is now available in multiple formats. For the present study, the program was delivered as a 14-week, group-based intervention, with each group session lasting 2 hr. Parents attended weekly groups focused on role play, activities, and discussion; take-home assignments were given to integrate each week's learning goals into parents' daily lives with their children. Each group comprised four to 15 parents and was led by two or three facilitators. These facilitators were military and nonmilitary social service providers (e.g., social workers, psychologists, school guidance counselors) who received extensive training and coaching before and during program delivery. Weekly groups infused military culture into content and included

topics such as creating a united parenting front after a return from deployment and responding to children's anxiety and fears about deployment. In addition, one or two mindfulness exercises, each lasting 2–20 min, were integrated into each group session to improve parents' present moment awareness; these exercises were also available to participants online for daily practice. Parents were also taught emotion coaching skills, including how to recognize and label their emotions and their children's emotions and how to pay attention and constructively respond to their children's emotions.

Measures

Intervention Status

Families were randomly assigned to the control or ADAPT intervention condition. Intent-to-treat analyses were utilized for all families randomized to the intervention regardless of whether they participated (see Figure 1 for a CONSORT diagram). Intervention status was dummy-coded as 1 for intervention and 0 for control.

PTSD Symptoms

Symptoms of PTSD were measured using the PTSD Checklist–Military Version (PCL-M; Weathers et al., 1993), a 17-item, self-report measure that is used to assess PTSD symptoms in response to stressful military experiences. Items on the scale are scored from 1 (*not at all*) to 5 (*extremely*) and parallel the diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (fourth ed., text. rev.; *DSM-IV*; APA, 2013) associated with Criterion B (i.e., reexperiencing; five

items), Criterion C (i.e., avoidance/numbing; seven items), and Criterion D (i.e., hyperarousal; five items). Using the symptom cluster scoring method corresponding to the *DSM-IV* diagnostic criteria, participants were considered likely to meet the clinical criteria for PTSD if they endorsed at least one Criterion B item, three Criterion C items, and two Criterion D items with a score of 3 (i.e., *moderately*) or higher; a dichotomous PTSD variable was then created to indicate whether a participant was likely to meet the *DSM-IV* PTSD diagnostic criteria. In the current sample, 15.2% of participants met the clinical criteria for PTSD at baseline, and 14.9% of the sample met the criteria at 1-year follow-up. The PCL-M has demonstrated good internal consistency and validity (Wilkins et al., 2011). However, due to the lack of diagnostic accuracy of the PCL compared to clinical interviews (McDonald & Calhoun, 2010), this measure was only used as a screening tool rather than a diagnostic tool, and the dichotomous variable was used to provide a rough estimate of the percentage of individuals in the current sample who would likely meet the diagnostic criteria for PTSD. The sum score of all items for each cluster was computed, and Cronbach's alpha for internal consistency was .95 at baseline and .90 at 1-year follow-up. Two latent variables were created to indicate PTSD symptom severity at baseline and 1-year, respectively, as indicated by the three PCL-M symptom cluster scores. A confirmatory factor analysis (CFA) was conducted to confirm whether the data supported the three-facet structure of PTSD symptoms.

Inhibitory Control

Inhibitory control was measured using a computerized "go/no-go" (Braver et al., 2001). In the task, stimulus letters appear on screen for 250 ms, with an interstimulus interval of 1000 ms. Participants were instructed to press a button each time a letter flashed on the screen (i.e., "go" condition), except the letter X (i.e., no-go condition). The task was composed of 165 letters total, 33 of which were the letter X. A participant exhibits higher levels of inhibitory control when they refrain from hitting the button when an X appears. Participants were scored on how many times they hit the button in response to the letter X (i.e., commission error). For conceptual consistency, the score was reverse-coded to indicate inhibitory control such that higher scores represented higher levels of inhibitory control.

Program Engagement

Program engagement was assessed via attendance at face-to-face sessions and the completion of take-home assignments. The number of sessions attended (out of 14) according to the facilitators' record and the number of home assignments completed (out of 13) according to participants' self-report were used to indicate program engagement.

Covariates

Demographic covariates included parent age, parental educational attainment, and household income. Deployment-related covariates were included to ensure they did not confound the association between inhibitory control and PTSD symptoms.

These covariates included combat exposure and the total length of deployment, which were measured using the widely used and validated Deployment Risk and Resilience Inventory (DRRI; King et al., 2006). The scale comprises 30 "yes" or "no" items related to potentially traumatic events an individual might experience during combat (e.g., "I fired my weapon at the enemy") and following combat (e.g., "I saw bodies of dead civilians"). In the present sample, Cronbach's alpha values for these two subscales were .87 and .91, respectively.

Data Analysis

We conducted a preliminary analysis to examine study variable distributions and descriptive statistics. A CFA was then conducted for the two PTSD latent variables separately, with the overall model fit evaluated according to the criteria recommended by Hu and Bentler (1999): a comparative fit index (CFI) value greater than .95, a root mean square error of approximation (RMSEA) value less than .06, a standardized root mean square residual (SRMR) value less than .08, and a chi-square ratio (χ^2/df) less than 2.0. After establishing the measurement model, we first developed the main-effects model using intervention status to predict PTSD symptoms at 1-year follow-up while controlling for PTSD symptoms at baseline as well as the previously listed covariates. The covariance between the residual variances of each symptom cluster across time was estimated. The PTSD baseline latent variable and the observed variables at baseline, including covariates, were all permitted to covary in the model. We then created a structural model and added the interaction term Intervention Status x Father Baseline Inhibitory Control (mean-centered). The traditional simple slope tests probing the association between the dependent and independent variable at plus-or-minus 1 standard deviation moderator values might have been biased because plus-or-minus 1 standard deviation moderator values are specific to each sample, and the results might not generalize to the population. Therefore, to show the association between the dependent and independent variables at the continuum of the moderator values, the Johnson–Neyman approach was employed, and the region of significance was plotted (Johnson & Fay, 1950). The Johnson–Neyman technique yields exact values of the moderator variable (i.e., inhibitory control) where the association between the independent variable (i.e., intervention effect) and the outcome variable is statistically different from 0 (Preacher et al., 2007).

The PTSD data at 1-year had nonnegligible missing data, with 23.0% attrition of our subsample and a total of 26.2% data missing data on all PCL-M subscales at 1-year follow-up. We compared the fathers who were retained with the fathers who were not and found no differences regarding the intervention group versus the control group. However, we did find an association with fathers' educational attainment such that fathers with higher levels of educational attainment were less likely to have missing data at 1-year follow-up; therefore, we controlled for fathers' educational attainment in further analyses.

Table 1
Descriptive Statistics and Bivariate Correlation

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Treatment status ^a	—	.02	.04	.02	.08	-.04	.05	.04	.04	.01	.06	.05
2. Parent age (years)		—	.27**	.38**	-.02	.11	-.13*	-.08	-.17**	-.07	-.05	-.14
3. Education ^c			—	.43**	-.08	.13*	-.11	-.14*	-.15*	-.12	-.16*	-.19**
4. Income level				—	-.05	.00	-.10	-.08	-.11	-.06	-.06	-.05
5. Deployment month					—	-.11	.05	.10	.06	-.03	.02	-.02
6. Baseline IC						—	-.17**	-.16**	-.15*	-.19**	-.23**	-.22**
7. Baseline reexperiencing ^b							—	.78**	.75**	.68**	.61**	.58**
8. Baseline avoidance ^b								—	.77**	.64**	.69**	.60**
9. Baseline arousal ^b									—	.61**	.60**	.72**
10. 1-year reexperiencing ^b										—	.81**	.79**
11. 1-year avoidance ^b											—	.81**
12. 1-year arousal ^b												—
<i>M</i>	0.62	37.73	4.18	8.57	3.81	12.29	8.04	11.55	10.49	7.75	11.38	9.90
<i>SD</i>	0.49	6.62	1.29	3.60	1.83	6.37	3.70	5.33	4.50	3.46	5.41	4.25

Note. IC = inhibitory control.

^a 1 = intervention, 0 = control. ^b Assessed using the Posttraumatic Stress Disorder Checklist–Military Version. ^c 1 = GED, 2 = High school diploma, 3 = Some college, 4 = Associate's degree, 5 = 4-year college degree, 6 = Master's degree, 7 = Doctoral or professional degree.

* $p < .05$. ** $p < .01$. *** $p < .001$.

To handle missing data, we used full information maximum likelihood (FIML), which uses all available information from the observed data.

Results

Descriptive Statistics

Bivariate correlations (see Table 1) showed that the three indicators of PTSD symptoms at baseline and the three indicators of PTSD symptoms at 1-year follow-up were highly correlated both concurrently and longitudinally, $r_s = .58$ – $.81$. Baseline inhibitory control was weakly but significantly correlated with the three indicators of PTSD symptoms at baseline and 1-year follow-up, $r_s = -.23$ to $-.15$. Among the four control variables, only father educational attainment was positively associated with inhibitory control and negatively associated with PTSD symptoms, specifically avoidance and hyperarousal, at both baseline and 1-year follow-up. Although no significant correlations were detected, we still controlled for the other three covariates (i.e., parent age, income, and deployment length) in subsequent analyses.

Measurement Model

A basic measurement model was estimated before examining a structural model. The measurement model included two latent constructs: PTSD symptoms at baseline and PTSD symptoms at 1-year follow-up, with reexperiencing, avoidance, and hyperarousal symptoms as three indicators of each construct. We estimated the covariance of each indicator across, as the three indicators at baseline were highly correlated with the cor-

responding indicators at 1-year follow-up. The model fit for the measurement model was good, $\chi^2(5, N = 279) = 1.773$, $p = .880$, $\chi^2/df < 1.00$, CFI = 1.000, RMSEA = .000, SRMR = .008. The factor loadings ranged from .87 to .91, indicating a strong association between the three PTSD symptom categories and the latent constructs.

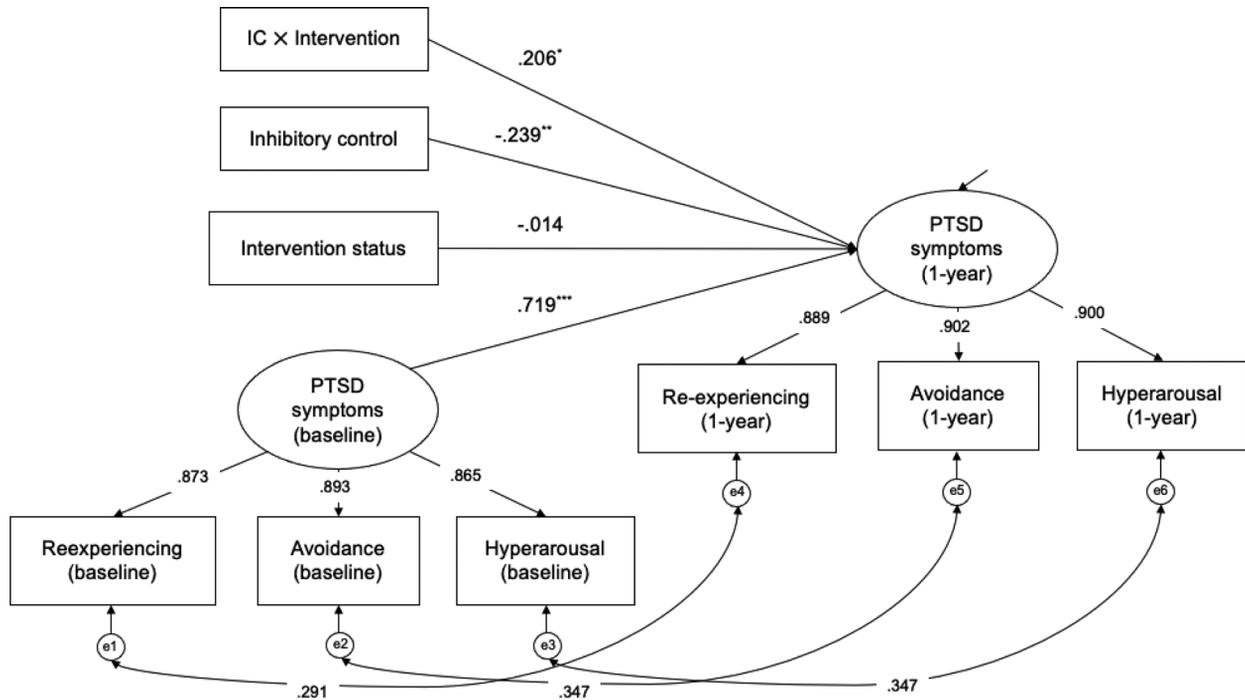
Structural Model

The main effect of the intervention (i.e., ITT effect) on deployed fathers' PTSD symptoms at 1-year follow-up was examined, controlling for baseline PTSD symptoms and other covariates. Fathers' inhibitory control at baseline was also added to the model to predict PTSD at 1-year follow-up. The model fit was good, $\chi^2(33, N = 282) = 34.806$, $p = .382$, $\chi^2/df > 1.00$, CFI = .999, RMSEA = .014, SRMR = .017. The intervention effect on PTSD symptoms at 1-year follow-up, controlling for baseline symptoms, was not significant, $B = -0.031$, $SE = 0.302$, $\beta = -.005$, $p = .917$, which indicated that there was not a significant difference PTSD symptom reduction for fathers in the intervention group versus the control group. None of the covariates were significantly associated with PTSD symptoms at 1-year follow-up.

A moderation model was then estimated by adding the interaction term of Intervention Status x Inhibitory Control (mean-centered) to the main effect model. The data fit this model well, $\chi^2(37, N = 282) = 41.429$, $p = .284$, $\chi^2/df > 1.00$, CFI = .997, RMSEA = .021, SRMR = .016. The interaction term was statistically significant, $B = 0.128$, $SE = 0.052$, $\beta = .206$, $p = .014$, which indicates that the intervention effect on PTSD symptoms was moderated by fathers' inhibitory control at baseline (see

Figure 2

Baseline Inhibitory Control Moderates the Intervention Effects on Posttraumatic Stress Disorder (PTSD) Symptoms



Note. Standardized values are shown. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 2 for other standardized coefficients). The regions of significance test of the interaction effect (Figure 3) showed that when a father’s baseline inhibitory control was lower than 1.062 standard deviations below the sample mean, which included about 17% of the sample, the moderation effect was significant. In other words, fathers with lower levels of inhibitory control at baseline who received the intervention had significantly larger decreases in PTSD symptoms from baseline to 1-year follow-up compared to the control group. However, the intervention did not effectively reduce fathers’ PTSD symptoms among participants with moderate or higher levels of inhibitory control.

Post Hoc Analysis

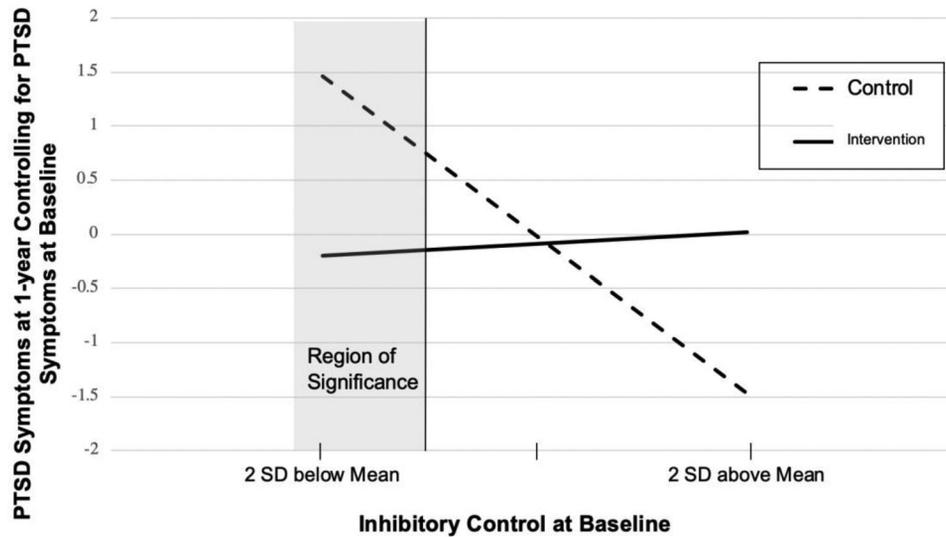
We conducted a post hoc analysis to examine the correlation between fathers’ inhibitory control at baseline and program engagement to ensure that the impact of inhibitory control on the intervention effect on PTSD symptoms was not confounded by fathers’ program engagement. The correlation was not significant for attendance, $r = -.09$, $p = .291$, or homework completion, $r = .00$, $p = .970$. Therefore, the moderation effect of inhibitory control was not explained by its impact on program engagement.

Discussion

The current study examined the role of military service members’ inhibitory control plays in moderating the effects of

a mindfulness-infused parenting intervention on their PTSD symptoms. The findings demonstrated that the intervention effect was indeed moderated by inhibitory control at baseline. Specifically, the ADAPT intervention effectively reduced service members’ PTSD symptoms at 1-year follow-up among those with lower levels of inhibitory control at baseline. The result is in line with our first hypothesis that individuals with poorer inhibitory control at baseline would show reductions in PTSD symptoms following the intervention.

The finding that inhibitory control moderated the intervention effect on PTSD symptoms for individuals with lower levels of inhibitory control is consistent with compensatory effects in the risk moderation hypothesis (Spath et al., 2006), which suggest that prevention and intervention programs are more effective for individuals with higher levels of risk. The results of a prior study on ADAPT also demonstrated that fathers with higher levels of emotion regulation difficulties showed more improvements in observed parenting practices (Gewirtz et al., 2019) relative to those with lower levels. Theoretically, compensatory effects are more desirable because high-risk groups potentially have a more substantial need for intervention. These effects are also more likely to emerge, as positive changes are more likely to be induced in individuals with lower levels of outcome variables or protective variables unless individuals’ risk characteristics compromise their engagement or responses to an intervention. Indeed, fathers’ inhibitory control was not significantly associated with their attendance at the intervention sessions in the present study. Although service

Figure 3*Johnson-Neyman Region of Significance Test for the Moderation Effect*

Note. PTSD = posttraumatic stress disorder.

members with low inhibitory control tend to have higher rates of PTSD symptoms (Monn et al., 2018), the present findings suggest that individuals with higher risk levels may benefit more from a parenting intervention in terms of PTSD symptom reduction.

The mechanism through which this parenting program decreased fathers' PTSD symptoms needs further investigation. Previous findings have demonstrated the effect of parenting interventions on parental mental health symptoms. The Strong Families Strong Forces Parenting Program, evaluated in a randomized clinical trial for service members with very young children, was also found to reduce PTSD symptoms in service members (DeVoe et al., 2017). This parenting intervention targeted parents' reflective function, which facilitates parents' awareness of and sensitivity to their own emotional states as well as their children's emotions. Although further research is needed, the authors speculated that reductions in PTSD symptoms may be related to increased reflective function, which is consistent with the hypothesized impact of skill-building in emotion regulation via mindfulness training on fathers' PTSD symptoms in the current study. Similarly, findings from an attachment-based parenting intervention for substance-using mothers demonstrated positive intervention effects on mothers' depression, psychiatric distress, and substance use, although the focus of the intervention was on improving parenting (Suchman et al., 2011). One of the key components of this intervention, reflective functioning, may increase parents' emotional awareness and emotion regulation, which may further account for the intervention's effect on parental mental health outcomes. In parallel, the current study integrated low-dose mindfulness exercises into the parenting intervention. These exercises, such as "sitting and observing," "10 deep breaths," and "body scan" may increase fathers' awareness in the present

moment and facilitate sustained attention to inner thoughts and feelings (Kearney et al., 2012). The increased emotion regulation may further benefit fathers' PTSD symptoms such that fathers are more likely to observe and attend to their emotions rather than avoiding emotional experiences or becoming emotionally numb or hypervigilant. Although the mindfulness exercises delivered in each session of ADAPT were short, and only half of the sample engaged in additional home practice exercises (Zhang et al., 2018), these exercises are likely especially beneficial to fathers with impairments in inhibitory control.

Another possible mechanism is that the intervention-induced improvement in parenting efficacy and effective parenting behaviors (Gewirtz et al., 2016, 2018) accounted for the changes in PTSD symptoms. Parents, especially fathers, may feel more competent in their interactions with children and experience increased family involvement during reintegration as they gain more behavioral parenting skills. Concrete strategies in the parenting program, such as "teaching through encouragement" and "limit-setting" provide deployed fathers with opportunities to practice emotionally charged parent-child interactions with specific tools. Increased self-efficacy and parental involvement may reduce emotional distress in deployed fathers, which, in turn, might lead to decreases in PTSD symptoms. This may be especially beneficial for individuals with lower levels of inhibitory control and higher levels of distress at program entry. In other PMTO studies, fathering identity and commitment to the parenting role were also found to predict reductions in health problems and substance use in divorced fathers (DeGarmo et al., 2010). Gewirtz et al. (2016) also found that the ADAPT intervention strengthened parenting efficacy, which was associated with later improvements in emotion regulation and psychological distress (i.e., PTSD and depression). Although the association between inhibitory

control and parenting efficacy is, as yet, unknown, it is possible that among individuals with poorer inhibitory control, the intervention-related enhancements to parenting efficacy may have bolstered the intervention effect on PTSD symptoms.

Additionally, the moderated intervention effect may not be specific to PTSD symptoms. Previous studies observed direct intervention effects of parenting programs on other mental health outcomes, such as parental depression, distress, and substance use (Gewirtz et al., 2016; Suchman et al., 2011). These effects may be also moderated by individuals' inhibitory control or emotion regulation at program entry. Further studies are needed to investigate whether the moderation effect of inhibitory control can be generalized to other mental health outcomes.

The present findings should be considered in light of the study's limitations. First, we acknowledge that the PCL-M should not be used as a standalone diagnostic instrument (McDonald & Calhoun, 2010) and that a "gold standard" PTSD assessment, such as a *DSM-IV* or *DSM-5* diagnostic interview or the Clinician-Administered PTSD Scale, was not administered in the current study. The PCL-M was instead used to assess the severity of PTSD symptoms, and we lack information about formal PTSD diagnosis in this sample of military fathers. Second, we could not determine the directionality of the association between inhibitory control and PTSD symptoms because we did not perform or have access to predeployment assessments of inhibitory control and PTSD symptoms. We cannot exclude the possibility that impairment in inhibitory control results from trauma exposure in combat zones or other predeployment traumatic experiences. Future researchers should measure inhibitory control and PTSD scores both pre- and postdeployment to better determine directionality. Third, we did not investigate the mechanism of the moderated intervention effect on PTSD symptoms. Improved emotion regulation and parenting efficacy are plausible candidates to explain the changes in PTSD symptoms and could be tested in further studies. Longitudinal studies are warranted to investigate the mechanism underlying the effects of mindfulness-infused parenting interventions on PTSD symptoms. It should also be noted that the current study focused exclusively on male service members because most mothers in the sample used in the original study were civilians. Further studies could test the association between PTSD symptoms and inhibitory control as well as the moderated intervention effects in female service members to ensure equity across genders.

In addition, the current intervention was a parenting-focused prevention program rather than a PTSD treatment program. Future studies could investigate the role of inhibitory control in interventions specifically designed for treating PTSD in military service members. Finally, it is noteworthy that the current sample of NG/R service members reported lower-than-average rates of PTSD compared with other postdeployment samples (e.g., 21.8% from 2002 to 2008 using national VA data, including active duty and NG/R veterans; Seal et al., 2009). It is conceivable that in a higher risk sample (i.e., composed of participants with PTSD rates closer to those reported in the lit-

erature), a larger proportion of service members would report decreases in their PTSD symptoms following this intervention, which could be examined in further studies.

The present study extended prior research on inhibitory control as a risk factor for PTSD symptoms by testing the moderating role of inhibitory control on the effect of a parenting intervention on PTSD symptoms. Although the primary target of the intervention project was not PTSD symptoms, the current study demonstrated that this multicomponent mindfulness-infused parenting program showed crossover effects on military fathers' PTSD symptoms. This finding draws attention to the potential benefits of parenting interventions on parental mental health for families facing mental health challenges. The current study also provides a unique contribution to the literature by emphasizing the role of inhibitory control. Although it is still unclear whether the moderation effect of inhibitory control only applies to parenting interventions or could generalize to any PTSD treatment, it seems worthwhile to assess neuropsychological characteristics at program entry, when feasible, and take into account the impact of these characteristics on participants' responses to intervention programs.

Open Practices Statement

The study reported in this article was not formally preregistered. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials can be sent via email to the first author at zhan4936@umn.edu or the corresponding author at agewirtz@umn.edu.

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