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Pre-Conception War Exposure and Mother and Child Adjustment 4 Years Later

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Abstract Evidence is accumulating for the transgenerational effects of maternal stress on offspring. A particular increasing concern is the possible transgenerational effects of community exposure to war and terror. Here, 107 mothers that had been exposed to war, were assessed with their 3 year old children (52 % girls) who had been conceived after the end of the war, and thus never directly exposed to war. The circumscribed nature (missile bombardment) and temporal limits (34 days) of the tragic 2006 Lebanon war in the north of Israel, affords a unique methodological opportunity to isolate an epoch of stress from preceding and subsequent normal life. We find that war experience engenders higher levels of mothers' separation anxiety, lower emotional availability in mother-child interaction, and lower levels of children's adaptive behavior. The novelty of these findings lies in documenting the nature and strength of transgenerational effects of war-related stress on offspring that were never exposed. In addition, because these effects were obtained after 4 years of a continuing period of normality, in which the children were born and raised, it suggests that an extended period of normality does not obliterate the effects of the war on mother and child behavior as assessed herein. Despite the study limitations, the results are indicative of persisting transgenerational effects of stress.

Exposure to terrorism, war and political violence are highly distressing and pervasive experiences that may have deleterious cross-generation ramifications (Kaitz et al. 2009; Masten and Narayan 2012). In the past decade interest has focused on the impact of prenatal exposure to such extreme maternal stress on offspring adjustment (Masten and Narayan 2012; Yehuda et al. 2005). An important expansion of these studies would be to examine whether maternal exposure to major stress *prior* to conception, wherein the offspring is not directly exposed as either a fetus or neonate, can affect postnatal development. Animal studies have shown that pre-conception exposure to mild stress in adolescent female rats is related to behavioral alterations that extend to the offspring, and has cross-generational effects on endocrine and brain function (Bock et al. 2014; Leshem and Schulkin 2012; McGown and Roth 2015; Shachar-Dadon et al. 2009), with a possible contribution of epigenetic alterations to maternal ova (Zaidan et al. 2013). In the current study, we examine transgenerational effects of pre-conception stress among humans. To that aim, we followed mothers in Israel who conceived 1–12 months after the 2006 Lebanon war, and

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evaluated the adjustment of mothers and their offspring at age 3 years. We specifically focused on outcomes that were previously found to be affected by war experience, including the mother-child relationship and the child's behavioral functioning (Kaitz et al. 2009; Panter-Brick et al. 2014; Smith et al. 2001; van Ee et al. 2012).

Theoretical Framework

The bioecological person-process-context-time model (PPCT; Bronfenbrenner 2005) provides a useful theoretical framework for this study. According to the PPCT model, development at any time point is a function of complex reciprocal interactions between individual characteristics, resources and skills (person), interactions with the immediate external environment (process), characteristics of immediate environmental settings, such as the home and the school (context), and changing sociocultural circumstances (time). In the current study, we sought to examine all four tenets of the PPCT model in the context of the Lebanon war. At the person level, we focused on children's adaptive behavior that allows them to function in their daily lives. At the process level, we focused on characteristics of mother-child interactions. At the context level, we focused on the home context, and examined mothers' emotional distress during the war and separation anxiety following the war. Finally, we examined how an event at the time level (i.e., the Lebanon war) exerts influences on the person, process and context levels. The novelty of this study lies in the examination of transgenerational effects from a bioecological perspective. In our study there is clear demarcation between the mother who is exposed to the war, and the child, who was not, even as a fetus. Yet, despite this dissociation, we propose that the war may exert influences on multiple levels of the child's bioecological system that may therefore be considered transgenerational.

War Exposure and Parenting

Accumulating evidence suggests that exposure to war related experience may have harmful effects on the mother-child relationship (Feldman and Vengrober 2011; Kaitz et al. 2009; van Ee et al. 2012). Women exposed to war or terror often report profound insecurities and fears regarding their children and their ability to function as mothers; and may find it difficult to provide sensitive guidance, structure and positive affect to their children (Kaitz et al. 2009). For example, mothers exposed to continuous war related experience in the Southern region of Israel showed lower levels of sensitive behavior and mother-child reciprocity when interacting with their children compared to control mothers who were not exposed (Feldman and Vengrober 2011; Feldman et al. 2013). Furthermore, higher levels of maternal posttraumatic stress

symptoms were associated with lower levels of maternal sensitivity and structuring and higher levels of hostility during mother-child interactions among asylum-seeker and refugee mothers and their children who were exposed to heightened political violence (van Ee et al. 2012). Less in known about the possible long term effects of war exposure on maternal parenting behavior. Studies focusing on parenting behavior of Holocaust survivors subsequent to World War II depict them as being over involved, overprotective and highly anxious, or neglectful and rigid in their parenting practices (e.g., Almagor and Leon 1989; Davidson 1992). However, most of these studies were based on subjective evidence or single case reports (Kellermann 2001) which limit the ability to gain a clear understanding of how experience of extreme stress may affect subsequent parenting behaviors.

War Exposure and Child Adjustment

Studies from diverse cultures in different war contexts, have documented the adverse effect of exposure to war on children's adjustment (Betancourt et al. 2015; Chemtob et al. 2010; Feldman and Vengrober 2011; Feldman et al. 2013; Masten and Narayan 2012; Panter-Brick et al. 2014; Smith et al. 2001). It has been suggested that children may be both directly affected by war exposure, and indirectly affected as a result of the impact of war exposure on their mothers' psychological functioning (Betancourt et al. 2015; Chemtob et al. 2010; Smith et al. 2001). For example, in Bosnian school aged children, both the extent of exposure to war and mothers' emotional distress were associated with children's emotional distress following the Bosnian war (Smith et al. 2001). Research conducted after the 2011 attacks on the World Trade Center (WTC) showed that maternal posttraumatic stress disorder (PTSD) and depression symptoms following the attacks were associated with increased emotional reactivity and aggressive behavior problems in preschool children (Chemtob et al. 2010). Moreover, infants of mothers who were pregnant during the WTC attacks and developed PTSD showed lower salivary cortisol levels in their first year than infants of mothers who did not develop PTSD (Yehuda et al. 2005), underscoring the relevance of prenatal exposure to war and related maternal emotional distress to children's future adjustment. In an attempt to elucidate the long-term effects of war exposure on unexposed offspring research has focused on children of Holocaust survivors. Overall, most studies do not provide evidence for long-term psychological problems in the first and second generation of Holocaust survivor offspring (Sagi-Schwartz et al. 2014; van IJzendoorn et al. 2003). However, parental PTSD symptoms following the Holocaust were related to lower cortisol levels and higher PTSD symptoms in adult offspring (Yehuda et al. 1998; Yehuda et al. 2014), implying that intergenerational affects are mainly mediated by parental emotional distress.

The effects of maternal pre-conception war exposure and distress on adjustment in *early* childhood remain unknown. Focusing attention on early childhood is particularly important because during these years the roots of emotional, cognitive and social skills are established and self-regulatory systems emerge (Calkins and Hill 2007; Sameroff 2010; Sroufe et al. 2009). Because this developmental period holds great promise for interventions to prevent and reduce risk and promote resilience (Masten and Gewirtz 2006; Shonkoff 2010), it is essential to examine the possible after-effects of preconception maternal war stress on mothers and their children at this age. We specifically focus on parenting and child functioning at age 3 years. The importance of the socialization of adaptive self-regulatory and social behaviors as children transition from toddlerhood into the preschool years and beyond makes the provision of sensitive and emotionally available parenting vital during this developmental period (Greenberg et al. 1993). It has also been suggested that the period from 3- to 11-years of age is marked by pronounced plasticity in the prefrontal cortex (Davidson et al. 2000); a brain region that has been implicated in higher order cognitive regulatory abilities that are essential for both academic and social functioning. Therefore, children at the preschool period may be particularly susceptible to the effects of contextual factors, such as parenting practices and behaviors, on their emotional and cognitive functioning.

The Current Study

The 2006 war between the Lebanese Hezbollah and Israel, on the Israeli side, provides a unique opportunity to study transgenerational effects through a bioecological framework. Unlike most strife that is preceded and followed by a period of increased tension, disruption and fearful events, the Lebanon war erupted unexpectedly as a missile bombardment on the north of Israel, and ceased equally abruptly 34 days later after which near normal life was restored almost immediately (Lev-Wiesel et al. 2008; Wolmer et al. 2011). Moreover, the type of threat was primarily circumscribed to missile bombardment, of which some 4000 landed in the northern region of Israel; there was little fear of enemy invasion and basic services were minimally disrupted. Thus, the period of stress was sharply demarcated, its characteristics circumscribed and consistent. Building upon animal studies that demonstrate the effects of maternal pre-conception stress on offspring adjustment (Bock et al. 2014; Leshem and Schulkin 2012; McGown and Roth 2015; Shachar-Dadon et al. 2009; Zaidan et al. 2013), and applying a bioecological framework (PPCT; Bronfenbrenner 2005), the current study examined the links between war exposure and maternal emotional distress during the 2006 Lebanon war and subsequent mother and child adjustment among mothers who conceived 1–12 months after the war. Unlike previous studies in which both mothers and children were directly exposed to war, making it difficult to disentangle effects of direct exposure versus intergenerational transmission and effects that parents and children may have on each other, the current study focused on children who were not directly exposed to war experiences in utero or neonatally. This unique design enables us to examine whether exposure to acute temporary war-related stress may have adverse intergenerational effects. A novel aspect of the study is the examination of the interactions between four levels of the child's bioecological system, including person (i.e., children's adaptive functioning), process (i.e., mother-child interactions), context (i.e., mothers' war-related emotional distress and subsequent separation anxiety) and time (i.e., the Lebanon war). We hypothesized that higher exposure to war experiences would be related to elevated levels of maternal emotional distress during the war, which would be related to elevated maternal separation anxiety, less optimal parent-child interactions and lower child adaptive functioning at age 3 years of the child.

Methods

Participants

Ethics approval for the study was obtained from the participating hospitals and the University of Haifa. Participants were mothers who conceived during the first month after the war (August–September, 2006), the 6th, (November–December, 2007) and the 12th (May–June, 2008), and gave birth to healthy, full-term infants with no apparent developmental difficulties. The different time intervals between the end of the war and conception were chosen to reveal whether the passage of time between war and conception might have a mitigating effect on the child measures. However, this question is beyond the scope of the current report and will be addressed in subsequent reports. Mothers were recruited to the study after giving birth. In order to generate variability in war exposure experiences, mothers were recruited from two locations: The Western Galilee Hospital in the northern region of Israel (an area that sustained bombardment during the war), and Sheba Medical Center in central Israel (beyond missile range). In the initial assessment, mothers who volunteered signed an informed consent form which described the war exposure and emotional distress questionnaires which they completed at home $M = 35.4$ $SD = 7.5$ months after the end of the war. They were also asked if they would consent to participate in a further stage of the study. Of the mothers who volunteered, 377 mailed the completed war exposure questionnaire to the University of Haifa (214 had been exposed to missile bombardment in the north, and 163 resided in central Israel, out of missile range).

Two-hundred-and-six mothers had indicated in the initial questionnaire that they would agree to participate in further study, and were invited to a follow-up assessment with their children. There were no significant differences on any of the measures between the mothers that self-selected to continue the study and those that did not.

Because our goal was to assess post-war adjustment among normally functioning families, we screened for mothers with possible clinical levels of PTSD applying the following DSM 5 (American Psychiatric Association 2013) criteria: 1) Exposure to actual or threatened death or serious injury; 2) Presence of at least one symptom from each of the four symptom clusters: intrusion, avoidance, negative alterations in cognitions and mood, and alterations in arousal and reactivity, and 3) Significant symptom-related distress or functional impairment. The PTSD screening questionnaire included 10 items that queried the presence of symptoms from the four clusters, and 2 items that assessed the degree of symptom-related distress and functional impairment in the 6 month postwar period. Mothers who met all three criteria above were excluded from the study ($n = 5$). Approximately 140 mothers agreed, but subsequently some failed to arrive to the assessment despite repeated rescheduling. The final sample included 109 mother-child dyads: 60 dyads that were directly exposed to the bombardment (northern region of Israel) and 49 dyads that were not directly exposed (central Israel). The assessments took place on average 3 years after the war ($SD = 0.63$), with over a year ($M = 1.1$ $SD = 0.4$) between the war exposure and completing the emotional distress questionnaire. During the follow-up assessment two dyads from the northern region of Israel were excluded after reporting that the child was born prematurely.

Table 1 presents demographic information concerning mothers and children from the two geographical areas. At the time of the follow-up assessment mothers from central Israel were older than mothers from the northern region of Israel $t(105) = 2.35$, $p = 0.02$, and children from the northern region were slightly older than children from central Israel $t(105) = -1.97$, $p = 0.05$. Furthermore, mothers from central Israel obtained more years of education than northern mothers $t(105) = 3.27$. The time interval (number of months) between the war and the follow-up assessment was slightly shorter among mothers from central Israel ($M = 47.04$, $SD = 6.25$) compared to northern mothers ($M = 49.69$, $SD = 6.24$), $t(105) = -2.18$, $p = 0.03$. No group differences were found in children's sex distribution and birth weight, and mothers' country of birth and number of children.

Procedure

The follow-up assessment took place in dedicated rooms in the two participating hospitals. The two rooms were designed similarly and included identical pictures, carpets,

Table 1 Mother's and children's demographic information by geographical area

		Northern region of Israel (direct exposure to bombardment) N = 58	Central Israel (indirect exposure to bombardment) N = 49
Maternal age (years)	M(SD)	32.36(4.27)	35.08(4.34)
Country of birth			
	Israel	83 %	78 %
	Other	17 %	22 %
Number of children	M(SD)	2.34(0.92)	2.02(0.85)
Maternal education (years)	M(SD)	14.97(2.36)	16.53(2.57)
Child sex			
	Female	57 %	45 %
	Male	43 %	55 %
Child birth weight (grams)	M(SD)	3303.76(475.63)	3325.51(540.01)
Child age (months)	M(SD)	34.03(2.97)	32.87(3.14)

child furniture, toys and video recording equipment. The same five research assistants and the first author conducted the assessments in both hospitals and two interviewers conducted each assessment. The assessments took place between November 2009 and July 2010 (3–4 years after the war). At the assessment, mothers signed informed consent forms, and completed a demographic questionnaire. Next, mothers and children participated in a 30 min filmed play session. Following the play session mothers filled out questionnaires that assessed children's adaptive behavior and mothers' separation anxiety. Children received a T-shirt with a cartoon animal print and the study logo and their playdough art work (below), travel costs were reimbursed, and mothers were sent a CD of the assessment in appreciation of their participation in the study. No other incentive was provided.

Among the 107 mothers and children in the study, 21 did not complete the child adaptive behavior questionnaire. Children with missing data did not differ from children without missing data in terms of maternal years of education $t(105) < 0.001$, ns, geographic location $\chi^2(105) = 3.02$, ns, and child sex $\chi^2(105) = 0.22$, ns.

Measures

Initial Assessment

War Exposure Levels of pre-conception exposure to war were rated by mothers using a questionnaire designed for the current study. Two aspects of war exposure were queried: *proximity to missile explosions* and *exposure to war related damage*. Proximity to missile explosions was evaluated by

mothers rating their proximity to areas that were bombed on an 8-point scale ranging from 1(*none of the missiles fell in proximity to my location or to people I know*) to 8 (*missiles fell in close proximity to my location and endangered the lives of me or my close family*). Exposure to war related damage was evaluated by asking the participants to rate on a 5-point Likert scale ranging from 1(*not at all*) to 5 (*very much*) the extent to which they experienced the following seven events during the war: personal injury, familiarity with injured, familiarity with killed, damage to personal property, familiarity with others who experienced damage to property, personal damage to livelihood and familiarity with others who experienced damage to livelihood. Scores from these seven items were summed to create the exposure to war related damage composite (score range: 7–21), with higher scores indicating higher exposure to war related damage. The current study employed a latent pre-conception war exposure factor that included proximity to bombed areas and exposure to war related damage.

Emotional Distress during the War Mothers' emotional distress during the war was evaluated using a questionnaire designed for the current study. The emotional distress questionnaire included 2 scales: *anxiety/helplessness* (12 items; e.g., To what extent did you experience feelings of anxiety throughout the war?, $\alpha = 0.83$) and *physical reactions* (13 items; e.g., To what extent did you experience abdominal pain during the war?, $\alpha = 0.83$), and mothers were asked to rate their experiences on a 5-point Likert scale ranging from 1(*not at all*) to 5 (*very much*). The current analysis employed a latent emotional distress factor that included the anxiety/helplessness and physical reactions scales.

Because we sampled mothers at three different intervals of conception after the war, mothers differed in the time lag between the end of the war and the questionnaire completion. The Lebanon war ended in August 2006. Mothers from the 1-month interval completed the questionnaire between May 2008 – January 2010, mothers from the 6-month interval between April 2009 – December 2009, and mothers from the 12-month interval between September 2009 – August 2010. We examined whether the different intervals were related to mothers' reported war experiences. No significant differences were found in reported war exposure and emotional distress during the war between mothers who conceived 1, 6 or 12 months after the end of the war, $F(103–104)$ ranged between 0.61–2.67, *ns*. Further, no significant correlations were found between the time (in months) between the end of the war and the initial assessment and mothers' report of war exposure and emotional distress, $r(97–98)$ ranged between 0.00–0.06, *ns*.

Follow-Up Assessment

Separation Anxiety Mothers' separation anxiety was measured using the Maternal Separation Anxiety Scale (MSAS; Hock et al. 1989). The MSAS consists of 35 items divided over three subscales: separation anxiety (21 items; e.g., I miss holding or cuddling my child when I am away from him/her), perception of separation effects on the child (7 items; e.g., It will be difficult for my child to adjust to someone else taking care of him/her), and employment-related separation concerns (7 items; e.g., I would resent my job if it meant I had to be away from my child). Mothers rated the items on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with higher scores indicating higher separation anxiety. The current analysis employed the MSAS total scores which was a composite of all 3 subscales ($\alpha = 0.85$).

Mother-Child Interaction To assess the quality of mother-child interactions, the researchers left the dedicated room at the hospitals, leaving mother and child alone for a 30-min play interaction. Mothers were seated on the floor beside the children and a large container of varied age-appropriate toys. The play session included two different play contexts, unstructured and structured, to obtain a wider range of behaviors. In the unstructured play episode (15 min) Mothers were ask to "play with your child as you normally do." At the end of the unstructured episode mothers and children were asked to organize the toys back in the box (5 min). In the structured play episode, playdough was provided and mothers were asked to create something together with the child (10 min).

The mother-child interactions were coded using the third edition of the *Emotional Availability Scales* (EAS; Biringen et al. 1998), which assess the emotional quality of the parent–child interaction. The EAS are conceptualized as an interactive construct, thus the coding system consists of both parental and child behavioral dimension ratings. The four maternal scales: *sensitivity*, *structuring*, *non-intrusiveness* and *non-hostility*, and the two child scales are *responsiveness* and *involvement*. Sensitivity refers to the parent's attunement and responsiveness to the child's signals, while expressing warmth and emotional connectedness to the child. The scale takes into account the following elements: positive affect, clarity of perceptions, awareness of timing, flexibility, acceptance, amount of interaction, and ability to handle conflict situations. Scores range from 1 (*highly insensitive*) to 9 (*highly sensitive*). Structuring assesses the degree to which the parent appropriately structures the child's play by following the child's lead and setting limits to his or her behavior. Structuring ranges from 1 (*non-optimal structuring*) to 5 (*optimal structuring*). Non-intrusiveness refers to the parent's ability to interact with the child without being intrusive (i.e., being overprotective, or overstimulating) and to allow and promote opportunities

for the child to test autonomous pursuits. Non-intrusiveness ranges from 1 (*intrusive*) to 5 (*non-intrusive*). Non-hostility assesses the degree of parental overt and covert hostility toward the child. Scores range from 1 (*overt hostility*) to 5 (*no observed hostility*). Responsiveness to the parent assesses the child's willingness to follow the parent's suggestions and the display of signs of joy during the interaction. Scores range from 1 (*unresponsive*) to 7 (*highly responsive*). Involvement of the parent assesses the degree to which the child attends to and engages with the parent in play. Scores range from 1 (*uninvolving*) to 7 (*highly involving*). On all scales higher scores reflect more optimal emotional availability.

The play interactions were coded as a whole (unstructured and structured) by a team of seven trained coders. All scales were highly correlated ($r = 0.60–0.86$) with the exception of maternal non-intrusiveness that was moderately correlated to the other scales ($r = 0.30–0.40$). Thus, a mother-child interaction composite was created by standardizing and averaging the scales sensitivity, structuring, non-hostility, responsiveness and involvement. One gold standard coder recoded a random subset of tapes (20 %) to assess reliability, and the Intraclass correlation (IC) for absolute agreement on the composite score was 0.79.

Child Adaptive Behavior The *Adaptive Behavior Scale* from the Bayley Scales of Infant and Toddler Development, third addition (BSID; Bayley 2006) was used to assess children's adaptive behavior. The adaptive behavior scale assesses the daily functional skills of children. The areas measured within this scale include *Communication* (25 items; language, speech, listening, and non-verbal communication), *Community Use* (22 items; interest in activities outside the home and recognition of different facilities), *Health and Safety* (24 items; showing caution and keeping out of physical danger), *Leisure* (22 items; playing, following rules, and engaging in recreation at home), *Self-Care* (24 items; eating, toileting, bathing), *Self-Direction* (25 items; self-control, following directions, making choices), *Functional Pre-Academics* (23 items; letter recognition, counting, drawing simple shapes), *Home Living* (25 items; helping adults with household tasks, taking care of personal possessions), *Social* (24 items; getting along with other people: using manners, assisting others, recognizing emotions) and *Motor* (27 items; locomotion and manipulation of the environment). Mothers rated the frequency of their child's behavior on these scales on a 4-point Likert scale ranging from 0 (*is not able*) to 4 (*always when needed*). The scores for all the skill areas were combined to form the *General Adaptive Composite* (GAC), an overall measure of the child's adaptive development ($\alpha = 0.96$). Norm-referenced composite scores, with scores ranging from 40 to 160, with a mean of 100 and SD of 15, were calculated based on the norms provided by the publisher (Bayley 2006).

Covariates Of the demographic variables queried, only those differing significantly between the exposure groups were entered as covariates. These included: maternal years of education, maternal age, child age, and time interval between the end of the war and the post-natal assessment at age 3 years of the children. As previous research has demonstrated that both prior trauma and negative life events are risk factors for poor psychological adjustment (e.g., Turner and Lloyd 1995), we also controlled for the possible effects of previous traumatic experiences and stressful life events that occurred between the end of the war and the birth of the child. To assess prewar traumatic experiences we asked mothers whether they had experienced any of the following traumatic events: exposure to terror, physical or sexual assault, catastrophic accidents or any other life threatening event at any time point before the Lebanon war. Eighty-two mothers reported no previous traumatic experiences, 17 mothers reported experiencing one traumatic event, and 8 mothers reported experiencing more than two traumatic events. A composite score of previous traumatic events was calculated by summing the number of events reported by mothers. Postwar stressful events were assessed by asking about the occurrence of several stressful life events, including familial major illness, divorce, injury, death, health problems, exposure to terror and other wars, financial difficulties, physical or sexual assault and catastrophic accidents. Sixty-nine mothers reported no stressful life events, 23 mothers reported experiencing 1 stressful life event, and 15 mothers reported experiencing more than two events. A composite score of stressful life events was calculated by summing the number of events reported by mothers.

Analytic Strategy

Structural equation modeling (SEM) was used to test our hypothesized model (Schumacker and Lomax 1996). Models were parameterized using the AMOS 23 software package, using the maximum likelihood estimator. Model fit was examined using a number of fit indices, including χ^2, the comparative fit index (CFI; Bentler 1990), the Tucker-Lewis index (TLI; Tucker and Lewis 1973), and the root mean squared error of approximation (RMSEA; Browne and Cudeck 1993). A non-significant χ^2; CFI and TLI values above 0.90 and RMSEA values below 0.05 indicate adequate model fit. The scale of each latent variable was set by fixing the first factor loading to 1.0. In order to examine our research hypothesis, we estimated a model in which the latent variable pre-conception emotional distress (i.e., anxiety and helplessness and physical reactions) was regressed on the latent variable pre-conception war exposure (i.e., proximity to bombed areas and exposure to war related damage) and the outcomes measured at age 3 years of the child (i.e., maternal separation anxiety, child adaptive behavior, mother-child interaction) were each regressed on the latent variable pre-conception

emotional distress. Covariates (maternal years of education, maternal age, child age, the time interval between the war and conception, prewar traumatic events and postwar stressful life events) were included in the model only if they were significantly correlated to one of the follow-up assessment outcome variables.

Results

Descriptive Statistics

First, bivariate correlations between the covariates and variables of interest were estimated. Mothers' years of education were negatively correlated with mothers' separation anxiety, $r(104) = -0.41$, $p < 0.001$, when children were 3 years old. Furthermore, children's age during the follow-up assessment was positively correlated with mother-child interaction, $r(104) = 0.25$, $p = 0.009$. Finally, prewar traumatic experiences were positively correlated with maternal anxiety/helplessness, $r(105) = 0.21$, $p = 0.02$, and maternal physical reactions during the war, $r(104) = 0.43$, $p < 0.001$. The additional covariates (maternal age, time interval between the war and the post-gestation assessment and postwar stressful events) were not significantly correlated to any of the follow-up assessment outcomes and were thus not included in the next steps of the analysis. Next, bivariate correlations between the variables of interest were estimated, and these are presented in Table 2.

Structural Modeling: Links between Pre-Conception War Exposure and Subsequent Mother and Child Adjustment

The final model provided adequate fit to the data: $\lambda^2(21) = 26.91$, $p = 0.17$; CFI = 0.97; TLI = 0.93; RMSEA = 0.02. Significant standardized path coefficients indicated that higher pre- conception war exposure predicted higher levels of pre-conception emotional distress ($\beta = 0.70$, $p < 0.001$). Further, higher levels of pre-conception emotional

distress predicted higher levels maternal separation anxiety ($\beta = 0.22$, $p = 0.02$), less optimal mother-child interaction ($\beta = -0.18$, $p = 0.05$) and lower levels of child adaptive behavior ($\beta = -0.21$, $p = 0.05$) at age 3 years. Figure 1 presents the standardized path coefficients. Covariates that were included in the analysis (maternal education, child age and prewar traumatic events) are not shown in Fig. 1 for clarity.
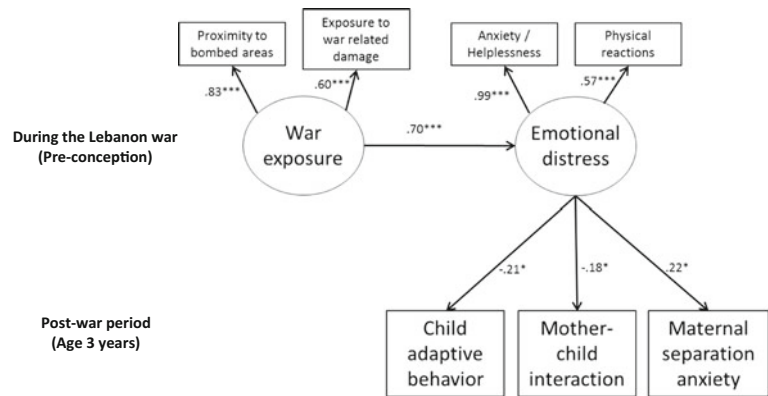
Preceding stages of model building regressed all of the post-natal endogenous variables on the 2 covariates (maternal education and child age). Maternal education significantly predicted maternal separation anxiety ($\beta = -0.34$, $p = 0.001$), but did not significantly predict children's adaptive behavior ($\beta = -0.14$, $p = 0.21$) or mother-child interaction ($\beta = 0.05$, $p = 0.55$) at age 3 years. Child age significantly predicted mother-child interaction ($\beta = 0.26$, $p = 0.005$), but did not significantly predict either children's adaptive behavior ($\beta = 0.08$, $p = 0.44$) or maternal separation anxiety ($\beta = -0.06$, $p = 0.49$) at age 3 years. A chi-square difference test that compared this model to a model in which the nonsignificant paths between the covariates and the exogenous variables were constrained to be zero revealed no significant differences between the models $\lambda^2(4) = 2.75$, $p = 0.60$, not supporting the inclusion of these parameters in the model. Thus, for the sake of parsimony, only maternal separation anxiety was regressed on maternal education, and mother-child interaction was regressed on child age in the final model. The latent variable pre-conception emotional distress was also regressed on maternal prewar traumatic experiences in the original model. Results from this analysis indicated that pre-conception emotional distress significantly predicted maternal separation anxiety ($\beta = 0.26$, $p = 0.01$), mother-child interaction ($\beta = -0.22$, $p = 0.03$) and child adaptive behavior ($\beta = -0.23$, $p = 0.05$) at age 3 years controlling for the effect of prewar stressful events on pre-conception emotional distress ($\beta = 0.22$, $p = 0.01$). However, model fit was unsatisfactory, $\lambda^2(18) = 2.28$, $p < 0.001$; CFI = 0.85; TLI = 0.65; RMSEA = 0.05. Analysis of modification indices suggested that prewar traumatic experiences variable is differentially associated with the two components of the emotional distress latent

Table 2 Bivariate correlations between study variables

	1	2	3	4	5	6	7
1. Proximity to missile explosions (pre-conception)	-						
2. Exposure to war related damage (pre-conception)	0.48***	-					
3. Maternal anxiety/helplessness (pre-conception)	0.57***	0.47***	-				
4. Maternal physical reactions (pre-conception)	0.34***	0.20*	0.61***	-			
5. Maternal separation anxiety (child age 3 years)	0.32**	0.10	0.33***	0.25**	-		
6. Child adaptive behavior (child age 3 years)	−0.10	0.06	−0.20'	−0.21*	−0.11	-	
7. Mother-child interaction (child age 3 years)	−0.04	0.03	−0.18'	−0.18'	−0.22*	0.14	-
Mean (standard deviation)	4.46 (1.93)	9.49 (3.55)	24.51 (7.15)	17.60 (6.17)	96.98 (13.52)	106.46 (11.93)	0.00 (0.90)

'<0.10, * < 0.05, **p < 0.01, *** < 0.001

Fig. 1 SEM model and standardized parameters of relations between pre-conception war exposure and emotional distress and post-gestation maternal separation anxiety, mother-child interaction and child adaptive behavior; *$p \leq 0.05$, ***$p < .001$; The model provides acceptable fit to the data $\chi^2(21) = 26.91$, $p = 0.17$; CFI = 0.97; TLI = 0.93; RMSEA = 0.02

Discussion

Although the number of young children growing up in post-war environments worldwide is increasing steeply (Masten and Narayan 2012), little is known about the subsequent psychological adjustment of exposed mothers and young children. This study is among the first to employ a bioecological perspective to examine whether exposure to war-related experiences and distress may exert transgenerational effects to offspring conceived *after* exposure to war. We found that women's higher exposure to war-related experiences was related to elevated emotional distress. In turn, mothers' emotional distress was related to higher levels of maternal separation anxiety, lower emotional availability in parent-child interactions and lower levels of child adaptive behavior. Consistent with the bioecological PPCT model that guided this study (Bronfenbrenner 2005), these findings demonstrate how sociohistorical circumstances that occurred before the child was conceived (the Lebanon war) exert influences on multiple levels of children's bioecological system, including mothers' own well-being, the parent-child relationship, and children's adaptive behaviors in the social, academic, personal and family context.

Our findings of the transgenerational implications of pre-conception war experience are remarkably similar to the effects of concurrent exposure to war on the mother-child relationship in early childhood (Feldman and Vengrober 2011; Kaitz et al. 2009; van Ee et al. 2012). Findings from the current study contribute to this literature by providing evidence for the long-term effects of war-related emotional distress on mothers' separation anxiety and parenting behaviors with children who were never exposed to the war, even during gestation. The determinants of parenting model proposed by Belsky (1984) provides a theoretical perspective for understanding these findings. According to this model, parenting behaviors are determined by the interplay of three components: personal characteristics of the parent (e.g., psychological functioning), social contextual influences of stress and support and the individual characteristics of the child. Parents' personal psychological resources are theorized to be particularly salient in this process because of both their direct influence on parenting behaviors and their important role in recruiting contextual support. Findings from this study demonstrate how contextual sources of stress (i.e., war exposure) are related to mothers' decreased psychological functioning which in turn has a negative effect on parenting, including elevated levels of separation anxiety and less optimal parenting interactions. Consistent with Belsky's model, we found that mothers' emotional distress played an important role in determining parenting cognitions and behaviors while contextual stress had an indirect effect on parenting through maternal emotional distress. Belsky further proposes that under circumstances of contextual risk, parental functioning is most protected when parental psychological functioning is intact, allowing sensitive involvement with the child even under extreme environmental stress (Belsky 1984). An important next step will be to examine maternal characteristics that can buffer the negative effects of war exposure on parenting. For example, factors such as self-regulatory skills, cognitive abilities, perceived agency and self-efficacy were all found to be important protective factors for adaptation in the face of war in extreme adversities (Masten and Narayan 2012). Moreover, examining child characteristics that may attenuate the link between maternal emotional distress and parenting behaviors, such as temperament and self-regulatory skills, and contextual sources of social support may provide a more comprehensive picture of the determinants of parenting model in the context of war experiences. Interestingly, animal studies show that

The modification indices analysis further suggested that prewar traumatic experiences should be allowed to covary with exposure to war-related damage and proximity to bombed areas separately, and that maternal education should be allowed to covary with physical reactions and anxiety/helplessness separately. The model was modified accordingly.

provision of environmental enrichment, whether to the parent or offspring generation, ameliorates the transgenerational impact of adversity on offspring behavior, providing evidence for possible protective intervention in the transgenerational transmission of stress (Leshem and Schulkin 2012).

Considering the effects on the children's adaptation, our findings expand the literature on the harmful effects of war-exposure on children (Betancourt et al. 2015; Chemtob et al. 2010; Panter-Brick et al. 2014; Smith et al. 2001; Yehuda et al. 2005) by demonstrating *pre-conception* transgenerational effects of maternal war related emotional distress on offspring adjustment. We specifically found that elevated levels of women's emotional distress during the Lebanon war were related to lower levels of their children's daily functional skills, such as communication, health and safety, self-care etc. Maternal war-related stress may affect future offspring adjustment through the attachment relationship that is formed between the mother and the child. Attachment Theory posits that parental sensitivity and emotional availability foster the formation of secure attachment between the parent and the child, and that such security provides an important foundation for children's healthy psychological development (Ainsworth et al. 1978; Bowlby 1969, 1973; Cummings and Cummings 2002). Experiencing early continuous interactions with a care-giver who exhibits maladaptive behaviors such as tension, irritability and hostility while interacting with the child may result in the development of an insecure attachment relationship, thereby fostering less confidence in the child about the caregiver as a reliable source of security (Cummings and Cummings 2002). Children who experience insecure attachment relationships and lack a sense of emotional security are prone to the development of maladaptive emotional regulation strategies and behavior problems (Cummings and Cummings 2002; Davies and Cummings 1994).

Animal studies have elucidated an additional route for transmission of pre-conception stress effects via epigenetic alterations in stress substrates in the mother's brain and ova, and subsequent alterations in offspring behavior, endocrine and brain microstructure (Bock et al. 2014; Franklin et al. 2010; Zaidan et al. 2013; Zaidan and Gaisler-Salomon 2015). The effects differ in male and female offspring, but the consistent finding that neonates born to preconception stressed dams already show alterations in brain functioning suggests that, at least in experimental rats, the changes in offspring behavior cannot be exclusively explained by alterations in nurturing ascribed to the mother's stress experience. Indeed, in male mice, having no contact with their offspring, stress alters the profile of DNA methylation in the promoter of several candidate genes in their sperm, and in offspring has transgenerational effects, altering brain DNA methylation associated with altered gene expression (Franklin et al. 2010). Alterations in offspring brain differ by sex, and have been documented in prefrontal cortex dendritic spine morphology

and hypothalamic-pituitary-adrenal axis function. Offspring behavior changes include altered social interaction, anxiety, and fear responses (Bock et al. 2014; Shachar-Dadon et al. 2009; Zaidan et al. 2013).

Currently we cannot determine how much of this applies to humans, certainly not to the mothers in our study, but there is increasing evidence for substantive transgenerational effects in humans on metabolism and health, including psychiatric disease, that appear to be independent of direct parental or social influence (Pembrey et al. 2014). It is incumbent on future research to disentangle the possible contribution of these epigenetic transgenerational routes.

Mothers indirectly exposed to bombings (residing in central Israel) had more years of education than mothers who were directly exposed (in the northern region of Israel). In line with the bioecological model (Bronfenbrenner 2005), maternal education is an important factor at the context level that can be related to various aspects of the process level, including parenting practices and mother child relationship quality (Brody and Flor 1998). The literature provides considerable support for the notion that maternal education is a significant internal resource that supports more positive parenting practices. For example, maternal education has been negatively linked to separation anxiety and controlling parenting practices, and positively linked to sensitive parenting behaviors (McBride and Belsky 1988; Tamis-LeMonda et al. 2009). Higher levels of education have also been associated with greater resilience (i.e., lower rates of PTSD) following war-related experiences (Bonanno et al. 2006). Thus, the lower levels of maternal education that were evident in mothers who were directly exposed to the bombings could partially explain the links between war exposure, emotional distress, parenting and child adaptive behaviors. In order to rule out the confounding effect of maternal education we included it as a covariate in the analysis, and found that the links between the variables were significant over and above the effects of maternal education. However, it is important in future research to further explore the role of maternal education in this process, for example as a potential buffer against the negative effects of war exposure on parenting and child outcomes.

Study Limitations

Findings from this study should be considered in light of some limitations. First, our assessments of the severity and specificity of the war experience and its effects, reported some 3 years after the war, are obviously subject to recall bias. The correlational nature of our findings leaves open the possibility that mothers with heightened baseline levels of emotional distress or difficulties with their child, might have reported past experiences as more stressful and threatening. Nevertheless, when comparing levels of emotional distress between war-exposed mothers (northern mothers) and those outside of missile range

(from the center), mothers who were directly exposed reported significantly higher levels of emotional distress, indicating that exposure to war-related damage accounts for the differences we note in levels of emotional distress. Second, because of time and resource availability (the war was not predicted, the project was assembled after it) we were not able to evaluate important aspects of the behavior of both mother and child, such as temperament during infancy, and earlier parenting behaviors. Including these early measures could provide a better understanding of the reciprocal links between mothers' war-related emotional distress and subsequent parenting behavior and offspring adjustment. It is also crucial to conduct follow-up evaluations of these mothers and children to determine the persistence and trajectory of the transgenerational effects. It should also be stressed, that the study permits no conclusion as to the transgenerational routes of the preconception war stress, namely to what extent they may be epigenetic (i.e., via the germline culminating in the child's behavior) and to what extent due to altered maternal behavior. Finally, and importantly, the circumstances of this war that confer its unique methodological advantages may also limit the generalizability of the findings. The 2006 Lebanon war on the Israeli side is not representative of the horrors of most wars, including the scale of death and injury, destruction and deprivation. One could speculate that such war experience would exacerbate the effects we report.

Summary and Conclusions

Millions of children worldwide are exposed to war and terrorism each year, and accumulating evidence suggests this exposure may have harmful effects on the parent-child relationship and children's adjustment (American Psychological Association 2010; Feldman and Vengrober 2011; Kaitz et al. 2009; Masten and Narayan 2012). Findings from this study expand the extant literature by providing evidence of persisting transgenerational effects of war-related stress on mothers, and their children who were conceived *after* exposure to war-related stress. We have yet to assess whether the passage of time and normality mitigate the transgenerational impact of the war, but our data do suggest that of itself, such an extended period of normality does not obliterate the effects of the war on mother and child behavior as assessed herein. Interventions aimed at supporting the wellbeing of war-affected populations should consider the multiple ecological contexts that may be negatively affected, including caregivers' and children's mental health and the quality of the parent-child relationship. Importantly, psychological, social and educational services should be appraised of possibly increased frequency of developmental difficulties in children conceived after exposure to war-related stress.

Compliance with Ethical Standards

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