Child Development in the Context of Disaster, War, and Terrorism: Pathways of Risk and Resilience

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Abstract

This review highlights progress over the past decade in research on the effects of mass trauma experiences on children and youth, focusing on natural disasters, war, and terrorism. Conceptual advances are reviewed in terms of prevailing risk and resilience frameworks that guide basic and translational research. Recent evidence on common components of these models is evaluated, including dose effects, mediators and moderators, and the individual or contextual differences that predict risk or resilience. New research horizons with profound implications for health and well-being are discussed, particularly in relation to plausible models for biological embedding of extreme stress. Strong consistencies are noted in this literature, suggesting guidelines for disaster preparedness and response. At the same time, there is a notable shortage of evidence on effective interventions for child and youth victims. Practical and theory-informative research on strategies to protect children and youth victims and promote their resilience is a global priority.

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INTRODUCTION

Millions of children worldwide are exposed to disasters, war, and terrorism each year, both directly and indirectly through effects on family, community, or society; lost opportunities; and media [Am. Psychol. Assoc. (APA) 2010, Becker-Blease et al. 2010, Furr et al. 2010]. Over the past decade since the World Trade Center attack on September 11, 2001, there has been an alarming series of devastating and highly publicized conflicts and disasters around the world, including terrorism, wars and political violence, earthquakes, tsunamis and hurricanes, industrial accidents, and large fires. As a result, many stakeholders are concerned with the impact of such extreme adversities on children and youth and what might be done to prevent or reduce exposures and consequences for young people, both in advance of catastrophic events and in the aftermath.

The goal of this review is to take stock of current research on the effects of disasters, war, and terrorism on children and youth in regard to conceptual perspectives, robust findings, gaps, and the utility of current evidence for applications. Recent situations are emphasized, particularly those occurring over the decade since 9/11. Excellent reviews and compilations of the research predating 9/11 have been published (e.g., La Greca et al. 2002; Norris et al. 2002a,b). This review is focused on extreme adversities and conditions that affect large groups of children or adolescents and their families at the same time, such as disasters and war (i.e., "mass trauma" experiences), and not on traumatic experiences that arise or happen to individual children and families, such as child abuse, assaults, car accidents, dog bites, and other life-threatening exposures. There are parallels in the concepts and findings in the literature on mass trauma and individual or family traumas, which are noted below, but it was necessary to limit the scope of this review.

The conceptual approach of the review, in keeping with the prevailing conceptual perspectives guiding much of the contemporary research, reflects a risk and resilience framework informed by developmental systems theory and the related core principles of contemporary developmental psychopathology (Betancourt & Khan 2008; Bonanno et al. 2010; Cicchetti 2006, 2010; Masten 2006, 2012;

Masten & Osofsky 2010). Following a brief section on historical perspectives, the salient features of this integrated conceptual perspective are highlighted. The subsequent literature review is organized around key components of risk/resilience models of disaster effects and responses: exposure dose, determinants, and mediators; variability in exposure effects on individuals, including correlates and moderators; and intervention, including exemplary experimental research and consensus guidelines. In the conclusion, we discuss the remarkable consistencies and conspicuous gaps in the literature reviewed and comment on the growing edges of interdisciplinary research on this topic.

Research Challenges

Although the quality of research has improved markedly since early scholars studied the effects of war and disasters on children, research on extreme adversities continues to pose great challenges (Bonanno et al. 2010, Masten & Osofsky 2010). Many ethical issues arise for research in the aftermath of disaster, when there is great concern about harming already traumatized victims and exposing researchers to traumatizing situations. Disasters often occur in remote or economically undeveloped locations with limited research infrastructure and measures available, or the disaster itself destroys or damages the existing infrastructure. Assessment tools suitable to the culture and situation may not be available, and physical or political conditions may be too chaotic or hazardous for research to be implemented. Pre-disaster baseline data is rarely available, and longitudinal follow-ups are challenging due to migration or chaos. Relevant comparison groups may be unavailable or difficult to engage. Finally, funding for such research may be hard to find, inadequate, or too slow in coming. These challenges make all the more impressive what has been accomplished by the investigators who have confronted the daunting issues of field research in the midst or aftermath of mass trauma exposure.

Historical Perspectives

World War II gave rise to a literature on children and war, heralded by Freud & Burlingham's (1943) volume *War and Children*, summarizing their observations, cases studies, and clinical experiences. They observed that there were few signs of "traumatic shock" among children exposed to bombing and other horrors of war when they were in the care of mothers or mother substitutes, but that it was quite a different matter when exposure occurred in a context of absent or lost parents. Accounts of child response to evacuations during the London blitz noted the traumatizing effects of separating children from their parents; many did so poorly they were returned home despite the dangers posed by the bombing (Garmezy 1983). The buffering effect of proximity to parents and other attachment figures for children in the midst of terrifying experiences is one of the most enduring findings in the literature on war and other life-threatening disasters.

After the liberation of the Terezin concentration camp, Anna Freud was in charge of six young orphaned children sent to England for treatment. Freud & Dann (1951) described many behavioral and emotional problems initially observed in these children, but also the strong bonds among them. Many of these and other children liberated from Terezin showed dramatic improvements over time; however, signs of "sensitization" or psychological "scarring" were noted among a substantial number of them. This mixed picture of resilience and lingering vulnerability or harm from extreme and prolonged trauma has continued to characterize the findings on children who survive the horrors of war, including recent cases of rescued child soldiers (Betancourt et al. 2010, Cortes & Buchanan 2007, Klasen et al. 2010).

Other than war, the best-documented observations of child responses to mass trauma or disaster have been reports on particular disasters, such as the Buffalo Creek dam disaster and an Australian bushfire. In 1972, a poorly constructed dam above the mining community

of Buffalo Creek in West Virginia burst and flooded the hollow and town below, killing 125 people, injuring many others and devastating this small community (Erikson 1976, Gleser et al. 1981, Korol et al. 2002). Although most of the observations on the child survivors were documented in the course of litigation, with concomitant issues of bias, the accounts have been influential because of their comprehensiveness. In addition, there was a long-term follow-up 17 years post disaster, which was the first of its kind (Green et al. 1994, Korol et al. 2002).

The findings from Buffalo Creek research have been widely replicated. Short-term findings (Gleser et al. 1981) indicated dose effects, with greater exposure to death of family and friends related to more symptoms. Many symptoms in the anxiety-trauma spectrum were observed, and anxiety symptoms predicted more lasting effects. Adjustment problems of children and adolescents were related to adjustment of parents as well as general family atmosphere (indexed by violence, irritability, gloomy mood, and less supportiveness). Girls were rated higher on anxiety symptoms whereas boys were rated higher on "belligerence." Older age at the time of exposure was related to more overall symptoms, particularly anxiety, depression, and belligerence. Adults had more symptoms than adolescents, who had more symptoms than young children, except that younger children had more specific fears and age-specific problems such as toilet-training lapses.

The 17-year follow-up indicated substantial recovery for most survivors, although they had higher current and lifetime rates of posttraumatic stress disorder (PTSD) than a comparison sample, with rates of 7% and 32%, respectively, as compared to 4% and 6% (Green et al. 1994). After nearly two decades, dose effects had largely dissipated; exposure was not strongly related to current function, although specific experiences, such as loss of family and relatives, had lingering effects. Thus, even after an event of this scope and severity, resilience and recovery were normative over the long term.

A second historically significant example is provided by one of the largest and best-studied disasters in the literature, the Australian bushfire of 1983 (MacFarlane 1987, MacFarlane et al. 1987, MacFarlane & Van Hooff 2009). MacFarlane reported initial findings through two years following the disaster and recently reported on results of a 20-year follow-up study. In early reports, MacFarlane observed more symptoms in the fire-exposed children (over 800 children attending primary schools in the devastated fire zone) than a comparison group of children recruited in 1985 (725 children) from a neighboring region not directly affected by the fire. MacFarlane (1987) also reported that child symptoms were more strongly related to separation from the mother or maternal symptoms than they were to dose or direct exposure, highlighting again the salience of parents and their function as a protective or vulnerability factor. The 20-year follow-up in 2009 showed lingering effects related to fire exposure, including anxiety, although differences were described as "relatively small" (p. 146). Bushfire victims reported comparatively high rates of PTSD symptoms of intrusion and hyperarousal related to the fire. Of the exposed children, those who reported another (usually subsequent) event as their "worst" lifetime experience had higher PTSD prevalence and severity, consistent with the possibility of cumulative effects from multiple trauma exposures and with models of "sensitization" or "kindling" that link prior and subsequent trauma exposures, discussed in more detail below.

Conclusions from early reviews of the literature on the extreme stressors of childhood drew conclusions that have held up well over the subsequent decades (Garmezy 1983, Garmezy & Rutter 1985, Rutter 1983). These reviewers concluded, for example, that trauma exposure could have lasting effects on children, though often the effects were short term; that loss and injury to loved ones had greater effects than material losses; and that parent availability, function, and support played significant roles in the responses of children.

CONCEPTUAL ADVANCES

Prevailing conceptual frameworks for understanding and intervening to improve the adaptation of children and youth in the context of disasters, terrorism, and war reflect the emergence over the past four decades of developmental psychopathology and related resilience frameworks for research and practice (Cicchetti 2010, Masten 2011, Masten & Obradović 2008, Pine et al. 2005). The pervasive influence of developmental systems theory (Gottlieb 2007, Thelen & Smith 1998) and Bronfenbrenner's ecological model (1979; Bronfenbrenner & Morris 2006) is evident in contemporary efforts to delineate the processes across multiple levels that lead to diverse phenotypic development in individuals and the different pathways observed in the aftermath of traumatic exposures (Cicchetti 2010; Masten 2006, 2011, 2012). In this perspective, adaptation to mass trauma experiences is conceptualized as a dynamic process involving multiple interacting systems within the individual organism and many interactions of the individual with complex and changing contexts, including relationships with other people and many interrelated systems of the natural and built environment. Individual adaptation will be influenced by the prior development of the individual as manifested in current function, adaptive capacity and strengths (assets; promotive and protective factors available to the organism), and vulnerabilities, as well as the nature of the current challenges impinging on the organism. The latter are often delineated in terms of risks, stressors, or exposure dose. Garmezy and Rutter pioneered this approach to disaster and its consequences for children, as noted above, and this perspective is now well established, as evident in recent reports on children in disaster [Natl. Commiss. Children in Disasters (NCCD) 2010] and war (APA 2010), special journal issues (Betancourt 2011, Masten & Cicchetti 2010), and reviews (Bonanno et al. 2010).

Over the past decade, there has been growing attention in developmental psychopathology and resilience science to multiple levels of analysis and the roles of gene-by-experience interactions and epigenetic processes in development and adaptation, particularly in the context of traumatic experiences (Cicchetti 2010, Sapienza & Masten 2011). As a result, models of adaptation to trauma have expanded to consider genetic and neural mediators and moderators of dose exposure and response. There is a rapidly emerging literature on the role of individual differences in genes, neural plasticity, and brain development in the processes of adaptation before, during, and following traumatic experiences. This new phase of research in trauma fields is transforming conceptual models of causes and effects of extreme adversity, as well as models of intervention. Selective examples are highlighted below.

Resilience in Dynamic Systems

Models have shifted dramatically in recent decades toward a resilience perspective, while at the same time acknowledging the salient role of traumatic exposures or "dose" as an influence on response (APA 2010, Betancourt & Khan 2008, Bonanno et al. 2010, Cicchetti 2010, Masten 2011, Masten & Obradović 2008, Masten & Osofsky 2010, Pine et al. 2005). Resilience can be defined as the capacity of a dynamic system to withstand or recover from significant challenges that threaten its stability, viability, or development (Masten 2011, 2012). Resilience is a dynamic concept that can be applied to many systems across scales, including systems within a person (e.g., stress-response system, immune system, cardiovascular system), the whole person as a system, a family system, a community or communication system, or an ecosystem (Masten 2011, 2012). A resilience framework holds particular appeal for research on child effects of extreme adversities because it highlights the shared goals of many stakeholders (individuals, families, communities, and societies) to mitigate risk and support resilience among children facing grave dangers.

Studies of risk and resilience in diverse populations of children exposed to significant

adversities, including war, terrorism, and disaster, indicate a very common set of factors associated with better neurobiological and psychosocial outcomes, often termed promotive factors (predictors of better outcomes under high- as well as low-risk conditions) and protective factors (especially important under high-risk conditions) (Cicchetti 2010; Luthar 2006; Masten 2001, 2007). These widely reported promotive and protective factors, such as self-control and problem-solving skills, close relationships with competent caregivers, or good schools and safe neighborhoods, suggest that adaptive capacity for resilience in the context of significant threats to adaptation and development depends to a large extent on fundamental human adaptive systems embedded in individuals, relationships, families, friends, communities, and cultures (Masten 2001, 2007). These adaptive systems can be harmed by severe adversities (e.g., a parent is killed; a community is destroyed) but often are hypothesized to protect children and promote recovery in the aftermath of war and disaster. In subsequent sections, we review recent evidence on promotive and protective factors for children facing extreme adversity, including research on their roles as naturally occurring compensatory factors or risk moderators and as potential targets for preventive interventions (Masten 2011, Masten & Obradović 2008).

Vulnerability and Sensitivity to Context

There also is great interest in moderators that potentiate the effects of adversities on children, including the sensitizing effects of earlier traumatic experiences, genetic moderators, disabilities, and personality differences (e.g., negative emotionality or ruminative tendencies), often termed vulnerability factors. There is rapid growth in research on genetic moderators (gene polymorphisms or epigenetic status) that appear to potentiate risk in the context of threatening environments (Cicchetti 2010, Kim-Cohen & Gold 2009, Nugent et al. 2011, Pratchett & Yehuda 2011). Although most of

the evidence to date has focused on child maltreatment, the implicated processes are likely to apply to many other forms of adversity characterized by extreme danger and violence. Growing evidence links variations in the serotonin transporter gene, 5-HTT, to susceptibility for anxiety and depression among children exposed to severe trauma. Variations in genes that regulate function of the hypothalamic-pituitary-adrenal (HPA) axis, which plays a key role in stress response, also have been implicated as potential moderators of trauma response in gene-by-environment (G x E) studies, including research on the corticotropin-releasing hormone type 1 receptor and glucocorticoid receptor genes (Cicchetti 2010, Nugent et al. 2011, Pratchett & Yehuda 2011). Additionally, recent advances in neuroimaging of children exposed to trauma indicate decreased brain volume and frontal cortex abnormalities in children with PTSD symptomatology, suggesting neurodevelopmental pathways of trauma effects that also could be related to genetic changes in children exposed to disasters (Carrion et al. 2010).

Recent theory and evidence also suggest that in some cases the purported vulnerability factors may actually be indicators of sensitivity or plasticity in response to experience, which could be bad in an adverse environment but good in a favorable one (Belsky et al. 2007, Belsky & Pluess 2009, Boyce & Ellis 2005, Ellis et al. 2011, Obradović & Boyce 2009). This raises the interesting possibility that some of the children who respond poorly to traumatic experiences may also respond well to positive changes in context provided by interventions.

In regard to the role of previous exposures to extreme adversity, one of the ongoing debates in the dose literature on trauma concerns the question of "inoculation" versus "sensitizing" effects (Bonanno et al. 2010, Silverman & La Greca 2002, Yehuda & Bierer 2009). Prior experience with trauma has been linked in adults and young people both with better response to subsequent traumatic experiences (congruent with an inoculation model) and with worse response, suggesting vulnerability-inducing

effects ("kindling" or sensitization model). However, as Bonanno et al. (2010) pointed out, there is limited prospective evidence to date for resolving this issue, and retrospective data is subject to many kinds of confounding effects when subjects simultaneously report on current symptoms and past trauma experiences. A stronger case can be made for inoculation effects when experimental designs are implemented; however, this is not feasible for testing kindling effects. We discuss an example of a recent stress-inoculation training experiment (Wolmer et al. 2011) in the Intervention section below.

Pathways of Adaptation in the Context of Extreme Adversity

The confluence of developmental change, promotive/protective influences, and vulnerabilities/sensitivities is presumed to result in multiple pathways of adaptation in the context of acute or chronic traumatic experiences. Describing different pathways has been a keen interest of investigators studying the impact of adversity or trauma on individuals and their developmental course (see Bonanno 2004; Bonanno et al. 2010; Masten 2011, 2012; Masten & Obradović 2008; Masten & Reed 2002; Silverman & La Greca 2002). Pathway patterns described in the literature, often inspired by case reports as well as empirical observations, show remarkable similarity to each other as well as to pathway models of resilience in other fields, particularly ecology (Tugel et al. 2005), suggesting the potential for a broad theory of adaptation, resistance, and resilience to disturbances in complex, dynamic systems (Masten 2011). **Figures 1*a*** and **1*b*** illustrate commonly described pathway patterns of adaptation in response to (*a*) a disaster with acute-onset and gradually improving conditions and (*b*) more chronic-onset extreme situations such as war or severe neglect/abuse that subsequently remit or improve. Some of these patterns remain speculative for children and youth. For example, there is considerable interest in the possibility of posttraumatic growth effects, where adaptation improves in the context of adversity (Bonanno et al. 2010, Masten & Osofsky 2010), reflecting a kind of challenge model; however, pertinent data are extremely scarce to date for children (Kilmer & Gil-Rivas 2010).

Cascading Consequences

Dynamic, developmental system models also suggest that the effects of traumatic experiences can spread over time, from one domain to another, from one level to another, from one person to another, and from one generation to the next, through a multitude of mediating processes. These effects have been called progressive effects, transactional effects, snowball effects, chain reactions, contagion effects, and developmental cascades (Masten & Cicchetti 2010, Pine et al. 2005). Within an individual's life, for example, stress can alter gene expression leading to alterations in brain development (Hochberg et al. 2011, Meaney 2010). These changes can be passed on to the next generation, through biological, behavioral, or socioeconomic processes, including gene methylation, disrupted parenting, or educational attainment. The disruption of adaptive behavior in one area of function can spread to affect other domains of behavior. Posttraumatic symptoms, for example, can disrupt function in school or work (Masten & Cicchetti 2010). In situations of terrorism and torture, perpetrators have the explicit objective of propagating psychological fear and terror across large groups of people (Pine et al. 2005), which can have lasting effects for subsequent generations of offspring (Yehuda et al. 2007).

On the other hand, positive adaptation, protective effects, and resilience also have the potential to spread within individual lives and across generations or populations (Masten & Cicchetti 2010). This possibility has inspired considerable interest in strategies of prevention and intervention that are targeted and timed to initiate cascades, aiming to prepare and protect individuals and communities, not only in the short term, but with expanding effects over time and domains (Fisher et al. 2006, Patterson et al. 2010).

Subsequent sections of this review address the components and processes implicated by these concepts and models of adaptation with respect to the status of research on the effects of exposure to war and disaster in childhood. We focus on the nature and perception of threats impinging on individuals; the developmental and functional status of the individual before and during the period of exposure and response; resources and capacities available to respond to the disturbances set in motion by threat processes, including those embedded in social relationships; and numerous other moderating influences that confer vulnerability or protection in the course of adaptation to extreme adversity.

EXPOSURE: DOSE AND DETERMINANTS

It has long been observed that problems and symptoms tend to rise as the number, intensity, or severity of hazards pile up in a person's life, while at the same time striking individual
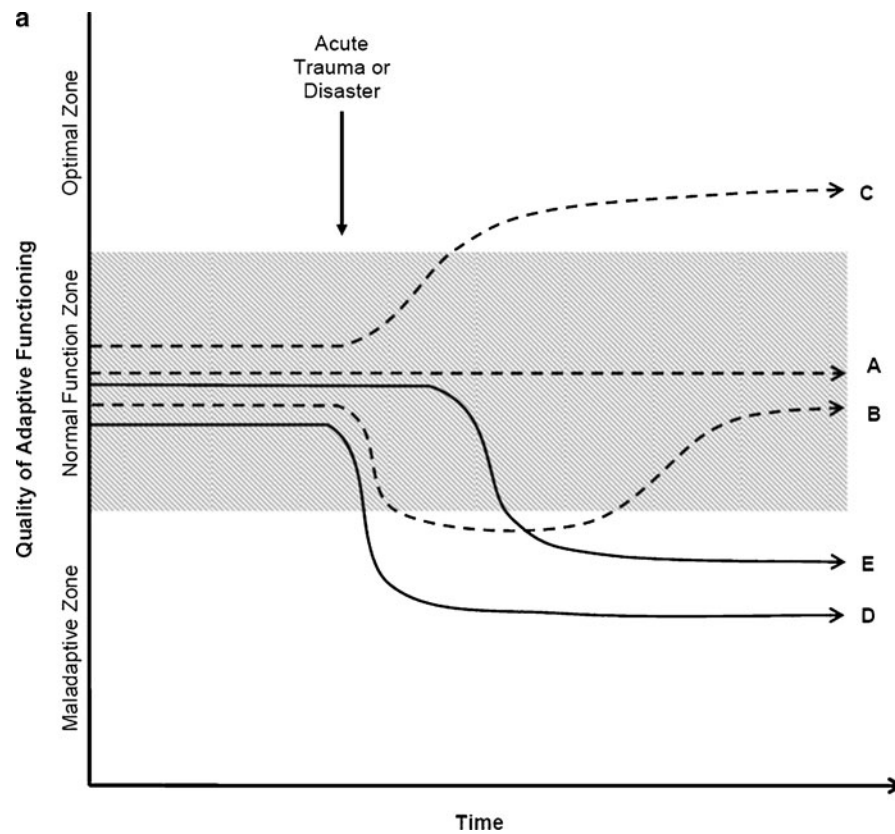
Figure 1

(*a*) Illustrative pathways of adaptive function before and after an acute-onset traumatic experience, such as a disaster or terrorism attack. Dashed paths illustrate forms of resilience, and solid lines indicate maladaptive pathways. Path A illustrates stress resistance. Path B illustrates disturbance with recovery. Path C illustrates posttraumatic growth. Path D illustrates breakdown without recovery (yet), and path E illustrates delayed breakdown without recovery (yet). (*b*) Illustrative pathways of adaptive function before and after exposure to prolonged and severe adversity. Dashed paths illustrate forms of resilience, and the solid line indicates a maladaptive pathway. Paths F and G illustrate decline in the context of chronic adversity and recovery after good conditions are established or restored. Path H illustrates decline with no sign of recovery (yet), despite more favorable conditions.
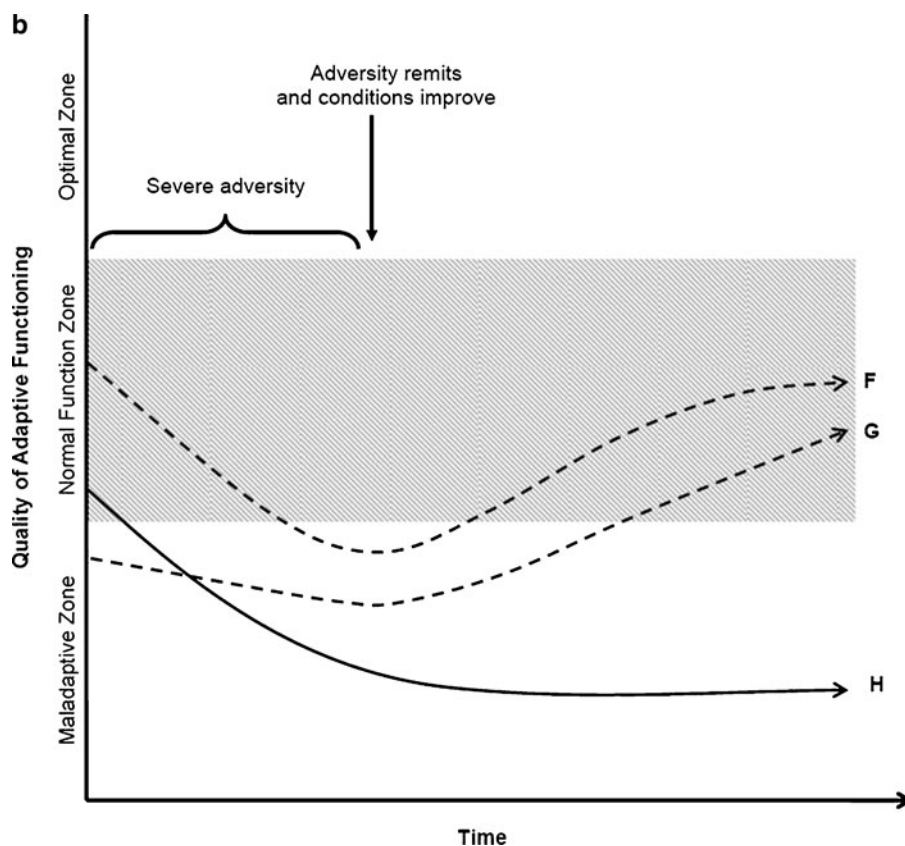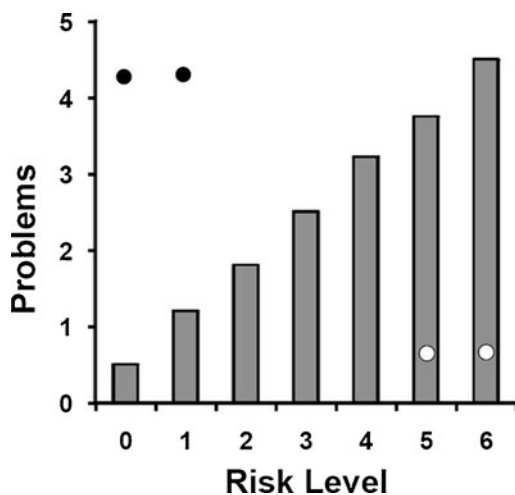
Figure 1

(*Continued*)

differences were noted among individuals sharing similar levels of risk or adversity (Masten & Obradović 2006). Evidence continues to support the general expectation that exposure to trauma or adversity of greater severity results in a higher average impact on the adaptation of individual children and youth as well as adults. However, there is growing interest in disaggregating dose to identify toxic experiences, understanding nonlinear effects, and delineating the processes that mediate observed dose effects.

Risk and Dose-Response Gradients

Theoretical risk gradients, such as the one shown in **Figure 2**, portray the idea of rising levels of problems as risk level rises. In studies

of trauma or disaster, these models are often described as dose-response figures. On average, for example, traumatic stress symptoms are expected to be higher as the frequency, number, or intensity of exposure rises. But the average level of symptoms may obscure wide variation among individuals at the same level of risk. Thus individuals may appear to be "off the gradient" in the sense that they are doing much better (implying protection or resilience, represented by white dots in the figure) or worse (suggesting vulnerability, represented by black dots in the figure) than one would expect in the population at this level of risk. A linear relation of risk/dose to adaptation is shown in **Figure 2**, but there are numerous other possibilities, including nonlinear threshold

Figure 2

Risk gradient illustrating a rise in average level of problems as a function of
higher risk level or exposure to trauma or adversities. White dots represent
individuals who are doing much better than average for a given level of risk
(suggesting resilience), and black dots represent individuals who are doing
much worse than average for a given level of risk (suggesting vulnerability).

models, asymptotic patterns, and inverted-U
and challenge models (see Luthar et al. 2000,
Masten 2012, Masten et al. 1988).

Dose-response gradients were observed by
early reviewers of the literature on extreme
adversity (Garmezy 1983, Garmezy & Rutter
1985), and they continue to be corroborated
in diverse reviews on children in extreme sit-
uations (Furr et al. 2010; Masten & Osofsky
2010; Norris et al. 2002a,b; Pine et al. 2005;
Qouta et al. 2008). "Dose" has multiple mean-
ings, and children generally show greater signs
of disturbance in response to more severe events
characterized in terms of multiple severity in-
dicators, including degree of severity of a single
exposure, accumulation or piling up of multiple
traumas or severe adversities, trauma occurring
in the context of ongoing adversity, and experi-
ences that strike at the heart of the attachment
relationship (when there is loss of connection to
caregivers or violence that threatens the core
attachment relationship, such as when a par-
ent is the victim or perpetrator of violence).
Similar dose gradients have been observed in
the broader literature on sociodemographic
risk and negative life events in the lives of

children, including child maltreatment (Masten
& Wright 1998, Obradović et al. 2012,
Sameroff 2006, Shonkoff et al. 2009).

In a recent meta-analysis of the empirical lit-
erature linking disaster to posttraumatic stress
(PTS) symptoms, Furr and colleagues (2010)
found a small to medium effect of disaster ex-
posure to PTS in children and youth across
all studies meeting inclusion criteria through
2009, with greater effects observed for disas-
ters characterized by greater loss of life and for
closer physical proximity to children, greater
perceived threat, and loss of a loved one or
friend. Assessment timing and informant effects
also were found in regard to dose: Studies con-
ducted within one year of the disaster showed
greater dose effects than those after one year,
and child reports showed greater dose-response
linkages than parent reports.

Studies published subsequent to this meta-
analysis show similar dose-related effects (see
Masten & Osofsky 2010). In terms of timing,
for example, Gershoff et al. (2010) found that
15 months after 9/11, only small effects related
to dose were observed for mental health func-
tion among adolescents, consistent with the
possibility that recovery may have already oc-
curred in many cases, even given initial dose
effects. In regard to worse effects when disaster
occurs in the midst of ongoing turmoil, Catani
et al. (2010) observed worse function in chil-
dren from Sri Lanka who experienced the 2004
tsunami in the context of ongoing war or in con-
junction with family violence, as well as worse
adaptation among children with greater direct
exposure to the tsunami itself. It is clearly im-
portant to consider the context in which "new"
traumatic experiences occur, both in terms of
conditions prior to onset and post-offset, as well
as the nature of war- or disaster-related trauma.
The question of how prior exposure to trauma
may moderate individual susceptibility to fu-
ture trauma, depending on the nature and de-
velopmental timing of exposure, is considered
elsewhere in this review, in relation to issues
of inoculation, sensitization or desensitization
effects, and biological alterations in adaptive
response systems.

The possibility of nonlinear or threshold effects in dose-response linkages is a topic of growing interest. Recent research on child soldiers exposed to extreme atrocities raises the possibility of exposures so high that nearly everyone would have passed a threshold expected to overwhelm normal adaptive capacity; therefore, beyond this threshold, additional trauma does not predict response, a kind of asymptote effect. In a recently published study of child soldiers in Uganda with extraordinarily severe and prolonged exposure to life-threatening atrocities and rape, Klasen et al. (2010) found that severity of exposure during captivity did not relate to function after these children returned. Instead, qualities of their recovery context, including exposures to violence and perceived spiritual support, were related to post-return function.

Other nonlinear effects are conceivable. Theoretically, it is possible that only when traumatic experiences pile up do young people show signs of disturbance. This kind of threshold could reflect the inherent limits in the capacity for adaptation: Individuals do fairly well until this capacity is exceeded, and then symptoms emerge, a kind of depletion model. On the other hand, higher levels of adversity could have a mobilizing effect. In their overview of research on Palestinian children in Gaza, Qouta and colleagues (2008) describe curvilinear effects where adaptive behavior declines as adversity exposure rises and then at extreme levels begins to rise again. They suggest that youth engaged in national political struggles were inspired to respond to extreme political violence with greater engagement, strength, or heroism.

There is considerable interest in knowing whether and how specific kinds of exposures cause more or specific kinds of problems in traumatized children and youth, particularly because this could be helpful for intervention design and planning. Layne and colleagues (2010) recently published a study of Bosnian adolescents exposed to war and political conflict that makes a compelling case for unpacking risk in order to illuminate dose-response processes and inform interventions to ameliorate

these risks. Exposure to life-threatening and traumatic bereavement experiences appeared to be "traumatogenic," which is consistent with other literature on events that pose high risk for posttraumatic symptoms or disorder among youth and adults, especially those including direct exposure to life-threatening violence (Kessler et al. 1995, La Greca & Silverman 2009). In their study of child soldiers from Sierra Leone, Betancourt and colleagues (2010) described the traumatic exposures to rape and killing others (tragically common among these young people) as "toxic experiences" with apparently long-lasting and distinctive effects. Youth with the experience of killing others showed increasing hostility in this longitudinal study of former child soldiers; the experience of rape was associated with anxiety and hostility and differential gender-related consequences discussed further below.

The Role of Media in Exposure

Interest in the role of media-based exposure during and after major disasters and war has expanded sharply as mass media and personalized media access have expanded. The potential for media exposure varies by the extensiveness of media availability and use in a given region of the world as well as by social class. Media exposure also potentially can be monitored and moderated by societies, media producers and broadcasters, parents, teachers, and oneself to a greater degree than direct exposures can be controlled.

Exposure through media can be extensive during and after a crisis (Comer & Kendall 2007). Although there is some research on the effects of media exposure to disaster on children and youth, primarily related to television viewing, there is little or no research yet available on the role of emerging social network exposures or personalized media exposure. Media exposure effects were reported after the Challenger explosion (Terr et al. 1999), Oklahoma City bombing (Pfefferbaum et al. 2001, 2003), and 9/11 attack (Lengua et al. 2005, Otto et al. 2007, Phillips et al. 2004, Saylor et al. 2003,

Schuster et al. 2001). Findings are consistent with dose effects, but interpretations are complicated by variations in age of viewers, media access and use, developmental understanding of the material, parental monitoring, and assessment strategies. Younger children may experience distress because they do not fully comprehend what they are watching, are sensitive to parental reactions, or do not know that the same incident is being replayed (Franks 2011). After 9/11, a study of Boston families (Otto et al. 2007) found an association of media exposure with PTSD symptoms in the younger children (age 10 or younger). On the other hand, older children are more likely to have greater access to media and might perceive greater threat because they understand the full scope of the situation (Comer & Kendall 2007, Comer et al. 2008).

Additional research on media dose effects (and moderators) is clearly needed. Meanwhile, developmental and child clinical experts who address this issue typically recommend that exposure for younger and more sensitive (e.g., anxious) children be carefully monitored due to the evidence of media dose effects (Bonanno et al. 2010, Comer & Kendall 2007, Lengua et al. 2005, Masten & Obradović 2008, Pine et al. 2005).

Determinants of Exposure

Some exposures to danger and disaster are random while others are not. There are communities, families, and geographical and geopolitical locations where the likelihood of traumatic exposures to natural and human-made disasters is greater, including earthquake-prone and war-prone regions. Exposures of many kinds are related to socioeconomic status (SES), and it is not surprising that SES-health gradients resemble dose-response gradients.

Often, age is found to relate to exposure in studies of disaster and war, with older children experiencing greater adversity (Masten & Osofsky 2010). Higher dose of exposure among older youth can be attributed to greater awareness of what is happening (related to

cognitive development), greater mobility, higher direct exposure to community effects and media exposure, more expansive social networks, and higher likelihood for older children and adolescents of being kidnapped as child soldiers, raped, or recruited into wars or unfolding disaster response efforts. In a rare national survey of exposure to disaster, Becker-Blease et al. (2010) and colleagues analyzed data from a Developmental Victimization Survey of 1,000 adolescents ages 10 to 17 and 1,030 caregivers of children ages 2 to 9 about exposures (both maltreatment and disasters, including terroristic attacks and natural disasters). Age was associated with higher exposure to disasters, both overall and within the two groups (adolescents by self-report and younger children by parent report).

Gender also is related to exposure, but in more complex ways. Males and females may experience different events, interpret and report them differently, and face different kinds of stigma or discrimination based on those experiences, which could also influence reporting (APA 2010, Masten & Osofsky 2010). In their overview of findings from studies of Palestinians living in Gaza, Qouta and colleagues (2008) suggested that parents in extreme threat situations tended to protect and restrict girls whereas they tolerated or encouraged boys to actively participate in the conflict, which would result in very different exposure risks as a function of gender. In her studies of child soldiers, Betancourt et al. (2010) found that female former soldiers reported more rape experiences than males and that sexual violence held greater stigma for females. Generally, greater risk is reported for young females to be victims of sexual trauma and sexual enslavement in political conflicts or war, whereas males have greater risk for exposure to nonsexual violence in armed conflict (APA 2010).

Mediating Processes of Exposure

There are many processes by which disasters and other extremely traumatic experiences could affect children and youth, including

direct and indirect pathways at multiple levels. Mediating processes include stress and its many consequences on the body and brain, neural function, and behavior. Direct pathways for children include the physical dangers posed by injury, starvation, contaminated water, toxins, radiation poisoning, or torture, as well as losses or degradation of physical caregiving. Indirect paths include the effects of extreme adversities on caregivers and, consequently, the quality of care or protection the caregiver can provide to dependent infants and young children. Psychological dangers to children include threats posed to loved ones, observing terrifying events, media portrayals of terrifying events, threats of torture, and self-blame. Moreover, from a very early age, children "read" the fear and concerns of their parents to gauge danger, a phenomenon called social referencing. Terrified parents are terrifying to their children (Masten et al. 1990). Thus, the effects of adversities can be mediated in many direct and indirect ways.

Stress processes and the immune system play a central role in the hazards posed by disasters and trauma of many kinds that children and youth experience, both prenatally and after birth (McEwen & Gianaros 2010, Shonkoff et al. 2009). Currently, there is keen interest in the biological embedding or embodiment of stress experiences in childhood and the possible long-term effects of trauma and disaster on development, health, well-being, and the stress reactivity of future generations. There is growing evidence in animal and human models that maternal stress may have "programming" effects on gene expression and the organization of the stress and immune response systems in fetal and postnatal development. Moreover, epigenetic processes now being delineated by numerous scientists provide plausible models of the processes by which such long-term effects could occur (Hackman et al. 2010, Hochberg et al. 2011, Meaney 2010, Miller et al. 2009). This rapidly expanding body of theory and evidence suggests that the timing of extreme adversities in human development may have long-term and even transgenerational

consequences. As a result, there is compelling reason to study the effects of traumatic experiences on the children of pregnant mothers and children exposed to intense trauma at different points in development, discussed further below.

Disasters and war also can disrupt many other aspects of life, including function and opportunities at the level of peer groups, schools, neighborhoods, communication systems, the economy, and international relations (Masten & Obradović 2008, Norris et al. 2008). These disruptions can cascade throughout regions and communities to impose many other adversities on children, youth, and families. Disasters may have enormous economic consequences, for example, that cause great stress to parents and young people.

INDIVIDUAL DIFFERENCES IN RESPONSE

Over the years, many clinicians and researchers have noted the marked variation in observed effects of disasters or war on individual children or youth, even for those who appear to be exposed to the "same" situation (Garmezy 1983, Masten 2011, Masten & Osofsky 2010, Rutter 1983). There has been considerable effort to identify correlates of the differential effects of disasters as a first step toward understanding the processes that might account for these differences, both in the individual and the context. The goal of informing prevention, planning, and intervention efforts provided a strong rationale for this body of research, with the expectation that eventually experiments to promote resilience by targeting these processes would serve to test causal models of risk and resilience (Masten 2011).

One of the challenges of research in the context of disaster is that often it is unclear whether observed or reported differences following a traumatic experience are related to exposure, or even whether they postdate the exposure. Predisaster data are rarely available, and there are few studies with low-exposure comparison groups. Also, it is often uncertain whether any differences observed among

groups or individuals reflect differences in exposure, response, perceptions, or response bias. Nonetheless, consistently observed differences do afford important clues to hot spots for further investigation (Masten 2007).

Gender

Gender is often studied as a correlate or moderator of risk and resilience in studies of disaster and war. However, as noted above, gender differences in adaptive outcomes are difficult to interpret because of gender-related differences in exposure, how males and females self-report on experiences and symptoms, and the meaning of exposure or behavior in gender-cultural context (stigma or how the self and others interpret the same behavior in males versus females) (APA 2010, Bonanno et al. 2010, Masten & Osofsky 2010). In addition, there are normative differences in the levels of internalizing and externalizing problems reported by and about males (more externalizing) and females (more internalizing), particularly in adolescence and beyond (Crick & Zahn-Waxler 2003), so it is difficult to determine whether a postdisaster difference reflects a change from predisaster functioning when there is no comparison group or pre- to post-disaster comparison data.

The most widely reported gender differences are greater distress and PTS symptoms observed in or reported by females, as noted by Furr et al. (2010) in their meta-analysis and in other reviews of disasters (Bonanno et al. 2010, Masten & Osofsky 2010), terrorism, or war (APA 2010, Comer & Kendall 2007). For example, nine months after a major industrial accident in Toulouse, France, that occurred shortly after 9/11 in 2001, investigators found that both younger adolescent girls (ages 11 to 13) and older adolescent girls (15 to 17) were more likely to display posttraumatic symptoms than either age group of boys (Godeau et al. 2005). Two years after the 2005 Hurricane Katrina, females in school-based assessments of young people ages 9 to 18 reported more symptoms of depression and PTS symptoms than males (Kronenberg et al. 2010). In one of the

few studies after Katrina that included a comparison group from similar socio-demographic backgrounds, Vigil et al. (2010) also found relatively high levels of depression among the exposed females compared to other groups.

There have been some reports of greater belligerence, hostility, or externalizing symptoms among males in this literature over the years, but the evidence is mixed (Masten et al. 1990). In their study after Katrina, Vigil et al. (2010) also found a significant interaction of exposure by gender for aggression, indicating that hurricane-exposed adolescent males in their study reported lower levels of aggression compared to males from similar socio-demographic background who were not exposed and females in the study.

More nuanced examinations of gender differences suggest an even more complex picture. For example, after terrorist attacks in Israel, girls reported more symptoms of PTSD and fear, but boys' symptoms were much more severe (Laufer & Solomon 2009). After a wildfire disaster in another study, girls reported more perceived threat than males but not higher rates of PTSD (McDermott et al. 2005). Recent reports also indicate that stress responses indexed by cortisol show different patterns by gender (Delahanty & Nugent 2006, Vigil et al. 2010).

To summarize, gender likely plays complex roles in the context of extreme adversity. Gaining clarity on these roles is going to require better methodology, including norm-referenced assessments, repeated measures, predisaster baseline data, and better comparison groups.

Age, Developmental Timing Effects, and Sensitive Periods

Developmental timing plays a key role in developmental theories of psychopathology and resilience, including many of the conceptual models applied to disaster and its effect on children (APA 2010, Franks 2011, Masten et al. 1990, Masten & Osofsky 2010). Developmental perspectives demand attention to the influences of both past and anticipated developmental changes in individuals over the course of

development, including changes in their cognition and interpretation of experiences, emotion and emotional understanding, self-regulation skills, knowledge, social connections and relationships, physical size and strength, beliefs and faith, and many other aspects of function that could influence their interaction with experience, including traumatic experiences. In addition, there are sensitive periods in development when a particular experience may have greater impact on development, either because the organism is especially vulnerable/responsive at that time or because a key experience-dependent adaptive system is organizing and it becomes "programmed" in response to an unusually traumatic situation that does not prepare the organism well for the subsequent environment. It has long been observed that physical traumas, such as brain injuries, have widely varying effects on subsequent development depending on the timing of the insult, time since the insult, and timing of assessment (Taylor & Alden 1997). Similarly, it is widely recognized that psychological trauma and physiological stress have differential effects related to developmental timing (Fox et al. 2010, Masten & Obradović 2008, Meaney 2010).

Recent advances in understanding the processes by which long-term effects of experience can become biologically embedded in a developing organism, and most specifically the processes of epigenetic change and experience-based programming of neural and neurobiological systems, have profound implications for research on the effects of extreme experiences on the developing individual (Cicchetti 2010, Gunnar & Quevedo 2007, Hochberg et al. 2011, Meaney 2010, Miller et al. 2009, Shonkoff et al. 2009, Yehuda & Bierer 2009). Animal studies and a growing human evidence base strongly suggest that the developmental timing of trauma and stress has different consequences for adaptation and development at multiple levels in the organism. Bad timing (discussed further below) can disrupt development, with long-lasting implications for adaptive capacity, health, and vulnerability to later trauma experiences.

Understanding the role of age differences or developmental timing of exposure on impact is complicated by differences in assessment methods as well as differences in exposure related to cognitive awareness and understanding, objective experiences, media access, and differences in adaptive capacities for survival and self-care. From a developmental perspective, young children would be expected to exhibit more acute symptoms of distress in response to separation from caregivers and disrupted routines. On the other hand, young children are actively monitored and protected by caregivers, and there is considerable plasticity in many aspects of early development, including brain development. Lack of awareness due to cognitive immaturity may be protective in some ways (the child is oblivious to some war atrocities and their implications for the future) and problematic in others (a young child separated from a parent may not understand that the parent is returning, or a young child watching television may not understand that video material is being aired repeatedly). Cognitive maturity is associated with great awareness of betrayals, lost futures, stigma associated with rape, and the scope of devastation but also with greater skills for problem-solving, planning, seeking help, and spiritual comfort. The consequences of the same event, such as loss of a parent, may be very different for a younger and older child. The younger child is more dependent on caregiving and thus highly vulnerable but may also elicit more care from surrogate parents than an older child.

Therefore, age and development would be expected to moderate exposure, functional capacities, and adaptive responses in many different ways, making the task of characterizing "age effects" quite difficult and complex, even though the evidence is generally consistent with developmental expectations (APA 2010, Franks 2011, Garbarino & Kostelny 1996, Masten et al. 1990, Pine et al. 2005). Younger children exhibit acute symptoms of distress or trauma, especially when they are separated from parents, when their parents have intense reactions, or when they are exposed to intense

media reports (Hoven et al. 2005, McDermott et al. 2005, Otto et al. 2007, Yelland et al. 2010). The developmentally differentiated response of others to traumatized victims of war and terror can be observed as well. In a study of returning child soldiers, those who were younger when they returned home were met with more acceptance than were older youth (Betancourt et al. 2010). To date, there are very limited data on the long-term consequences of differential timing of exposure by age for disasters.

One of the most provocative timing questions in the current literature concerns the impact of prenatal and infant exposures to extreme maternal stress resulting from terror and disaster that may have programming effects on the stress-response systems during sensitive windows of development (Yehuda & Bierer 2009). Yehuda and colleagues (2005) have reported that infants of 9/11-exposed pregnant mothers who developed PTSD had lower salivary cortisol levels than infants of mothers who did not develop PTSD. Moreover, infants' cortisol levels were lower with more severe maternal 9/11 exposure and were particularly low if mothers were in their third trimester. Yehuda and colleagues (2007, 2008) also have studied children of Holocaust survivors, finding that children of survivors with PTSD had lower cortisol levels compared to children of survivors without PTSD and parents not exposed to the Holocaust. Further, maternal (but not paternal) PTSD specifically was related to PTSD risk in the children. As noted above, recent models of alteration in gene expression related to glucocorticoid programming provide a biological model by which maternal stress could influence long-term stress regulation (and health) in offspring during prenatal exposure to stress or postnatal exposure to maternal care or both (Hochberg et al. 2011, McEwen & Gianaros 2010, Yehuda & Bierer 2009). The possibility that extreme stress experienced by mothers could alter the epigenetic status of their children has important implications for the pathways by which trauma could be transmitted to the next generation. Epigenetic processes also provide pathways of neurobiological change by which previous trauma exposure could alter future trauma vulnerability.

Previous Exposure to Trauma: Inoculation or Sensitization?

There has been considerable interest in the possibility that a history of some stress exposure (and adaptation) produces either protective effects (inoculation) or vulnerability effects (sensitization) with respect to future adaptation in the event of extreme adversity. These two possibilities can be integrated in nonlinear models, where moderate degrees of challenge met successfully have beneficial effects, preparing an organism for future challenges better than either no exposure or too much exposure (Rutter 2006, Seery et al. 2010). Stress inoculation training (see Meichenbaum 2007) methods, discussed in the subsequent section on intervention, are designed to prepare individuals or communities in advance to cope better with severe adversity. Presumably it is through processes involved in an adaptive response (analogous to the process of making antibodies after a vaccination) that an organism gains future protective effects for adapting to mild or moderate exposures. If so, then interventions designed to build capacity for resilience would need to scaffold or in other ways ensure an adaptive response in order to avoid risk of breakdown or depletion of resilience capacity.

Conversely, exposure to overwhelming or capacity-depleting levels of adversity might be unlikely to build immunity, but rather could be expected to induce vulnerability to subsequent exposure. Evidence on the effects of cumulative stress and trauma discussed above is congruent with such sensitization or cumulative effects. Recent work on biological programming of early stress and trauma in childhood, as well as functional changes in cortisol levels that adapt and stabilize under chronic stress, have important implications for children's reactions to subsequent stress or trauma. For example, one function of cortisol elevations in response to stress is to regulate adrenergic and catecholamine activity associated with

exposure to trauma and to consolidate trauma-related memories (Delahanty & Nugent 2006); however, exposure to trauma or chronic stress can lead to hypoactivation of the HPA axis (which may function to protect the developing brain from excessive cortisol) and depletions in available cortisol over time (Gunnar & Quevedo 2007). Dysregulation of these stress processes can lead to failure to mobilize an adaptive response in the face of subsequent trauma, increasing the risk for PTSD and intrusive or unintegrated memories of traumatic events (Delahanty & Nugent 2006, Yehuda & Harvey 1997, Yehuda et al. 1998).

In sum, exposure to trauma may have sensitizing effects on children that could lead to HPA axis dysfunction; however, findings on the exact nature of HPA disruption are still mixed. A variety of other factors, such as timing, dose, and length of exposure, genetic underpinnings, and availability of social support, likely also play a role in biological responsiveness following disasters (Pratchett & Yehuda 2011). However, the possibility that the stress regulatory system can be chronically altered from exposure to trauma and its developmental timing suggests that children exposed to trauma at an early age might become more vulnerable to subsequent stress or that children exposed to chronic life stress might be particularly vulnerable to the effects of subsequent trauma, as reported for adults by Yehuda and colleagues (2010). It is also conceivable that atypically low levels of cortisol in older children or adults after a traumatic event might be observed among individuals who have a history of previous trauma exposure (Pervanidou 2008). Recent developments in research on biological processes related to trauma represent an important and intriguing future direction for investigation.

Promotive and Protective Factors in Children, Families, and Relationships

Over the years, a consistent set of factors have been implicated as important for adaptation in the context of disasters, war, and many other extreme adversities faced by children and youth (APA 2010, Betancourt & Khan 2008, Cicchetti 2010, Garmezy 1983, Garmezy & Rutter 1985, Luthar 2006, Masten et al. 1990, Masten & Obradović 2008, Masten & Osofsky 2010). These factors, including intelligence, self-regulation skills, hope and beliefs that life has meaning, self-efficacy, close and supportive relationships, religious beliefs and practices, and community supports, likely reflect powerful adaptive systems resulting from biological and cultural evolution (Masten 2001, 2012). Many studies, until very recently, have focused on psychosocial factors. Now, with advances in assessment of genes, biomarkers, and brain function, there is a surge of research on neurobiological processes in adaptation to severe threats, including disasters and war, as well as child maltreatment and family violence (Cicchetti 2010, Sapienza & Masten 2011).

Attachment relationships. Beginning with early studies and continuing to date, researchers have noted the importance of attachment relationships and the functional capabilities of the caregiver for children exposed to disasters and other severe adversities. As noted above, the negative effects of separation from or loss of caregivers during crises was identified long ago as a crucial factor for children, and the functional status of parents—before, during, and after disasters—was recognized as a key influence on child response. Recent research corroborates these observations across diverse calamities. Symptoms in parents could affect children either by undermining parenting behavior or alarming children more directly (even young children perceive emotional distress in parents) or both. Parents who had more mental health symptoms after 9/11 had preschool children who were not doing as well as their peers, according to their teachers (Chemtob et al. 2010). Other studies focus explicitly on parenting, parent-child interaction quality, and perceived family acceptance. Qouta et al. (2008) reported that strong family relationships predicted resilience among children exposed to political violence in Palestine. The quality of parent-child relationships moderated the

association of tsunami exposure on adolescent symptoms of PTSD and depression (Wickrama & Kaspar 2007). Family acceptance was associated with all of the outcome indicators of adaptive recovery in child soldiers studied by Betancourt et al. (2010).

Although considerable evidence has linked effective parenting to resilience in disasters and war, it is important to consider whether parents could undermine resilience through overprotectiveness. Bokszczanin (2008) found that high parental involvement after a flood in Poland was associated with higher risk for PTSD in adolescents. Adolescents may interpret high involvement as an indication of parental judgments that they are not capable, in effect undermining their self-confidence or perceived efficacy and agency. Bonanno et al. (2010) have raised this question more broadly in the disaster response field by noting that too much early intervention by outsiders may have the unintended effect of undermining adaptive processes in families and communities.

Cognitive skills and self-regulation. Cognitive skills (general intelligence and cognitive flexibility) and self-regulation skills are widely implicated as protective factors for children in a variety of hazardous circumstances, including disaster (Masten 2007, Masten & Obradović 2008). In a rare study with predisaster assessments, in this case prior to political conflict in Kenya, Kithakye et al. (2010) found that self-regulation skills in preschoolers predicted better postconflict outcomes (less aggression and better prosocial function), controlling for preconflict behavior. Self-control also moderated the effects of exposure severity on prosocial behavior. Similarly, Terranova et al. (2009) reported that effortful control abilities (shifting, planning, and inhibiting unwanted behaviors) buffered sixth-grade childrens' PTSD symptoms after Katrina, consistent with a protective effect. Studies of youth in Palestine also have suggested that cognitive capabilities are protective (Qouta et al. 2008).

Cognitive skills may be a mixed blessing, however. As noted above, more cognitively advanced children may better comprehend the scope of a disaster. Sprung (2008) found that 5- to 8-year-old children who had more developed theory-of-mind skills had more intrusive thoughts after Katrina but were also more receptive to learning strategies to cope with them.

Agency and self-efficacy. Perceived agency and self-efficacy are also associated with resilience in numerous studies (Luthar 2006, Masten 2007, Masten & Obradović 2008). In their longitudinal study of child soldiers, Betancourt et al. (2010) found that youth who survived rape had greater confidence, which they speculate may have resulted from enduring prolonged hardships during the years of captivity. Barber (2008) has found positive effects of activism during the Intifada on postconflict social and civic behavior among Palestinian youth. A sense of competence has also been identified to have protective/promotive effects. Greater competency beliefs promoted more posttraumatic growth in children ages 6 to 15 who were exposed to Hurricane Floyd (Cryder et al. 2006), and higher self-esteem protected against PTS in children ages 9 to 13 who experienced 9/11 (Lengua et al. 2005).

Personality. Personality differences that could influence stress reactivity also have been studied for decades, with particular interest in negative emotionality (the tendency to respond with negative emotion and get upset easily). Though not commonly studied, recent studies continue to verify the importance of individual differences in negative emotionality. In a small study of adolescents exposed to Katrina with prehurricane assessment of this personality trait, negative emotionality predicted postdisaster symptoms of anxiety, depression, and PTSD (Weems et al. 2007). The tendency of individuals to ruminate also holds interest, because rumination is associated with risk for depression among adolescents and adults (Nolen-Hoeksema et al. 2001). After Katrina, however, children's ruminative thoughts, both negative and positive, predicted posttraumatic growth in one study (Kilmer &

Gil-Rivas 2010). The investigators speculated that this finding might signify that rumination facilitates more processing of, meaning making about, and integrating of the experience into memory and identity.

Acculturation skills. For those young people who flee to new cultures and countries as a result of conflict or disaster, acculturation and language skills have been linked to better adaptation over time (APA 2010, Wright et al. 2012). A study of Somali and Oroma refugees (ages 18 to 25 at the time of assessment but typically in their teens at the time of emigration) found that language fluency was associated with fewer PTSD symptoms (Halcón et al. 2004). Language skills similarly were associated with more academic and social success in a study of highly traumatized Cambodian child survivors of Pol Pot who eventually immigrated to the United States (Hubbard 1997). In the same group of young people, positive American or bicultural identity also was associated with competence (Northwood 1996). These factors (language skills in the host nation and bicultural identity) appear to be broadly protective for immigrant youth who have experienced less trauma and are moving into culturally and linguistically different host countries (Masten et al. 2012, Suárez-Orozco et al. 2006).

Meaning and hope. Faith, hope, and spiritual beliefs or religious practices have been implicated in the broad resilience literature and also in a specific subset of disaster or war studies (Crawford et al. 2006). Faith and religion would be expected to have greater significance for older children and adolescents than young children. Among Ugandan former child soldiers, young people who showed posttraumatic resilience (better mental health) also reported more perceived spiritual support (Klasen et al. 2010). The widely reported role of spirituality and religion after devastating disasters or war in older youth and adults may reflect the broad significance of belief systems that give coherence and a meaning to life for resilience in devastating circumstances (Wright et al. 2012).

Neurobiological protections. Individual differences assessed at a neural or biological level remain extremely rare in the disaster literature. In one of these rare efforts, Vigil et al. (2010) assessed two biological systems in exposed and unexposed adolescents post-Katrina, the HPA axis (measuring salivary cortisol) and the sympathetic nervous system (measuring salivary alpha-amylase). The combination of high response in both systems appeared to be associated with resilience. Other studies of cortisol have suggested that low levels immediately following traumatic exposures may be a biomarker of risk for subsequent PTSD (Pervanidou 2008, Yehuda & Harvey 1997, Yehuda et al. 1998).

Broader Recovery Context: Promotive and Protective Factors in the Community

Beyond the family, research indicates that community context and community resilience are important for children and families (Betancourt & Khan 2008, Masten & Obradović 2008, Norris et al. 2008). In extremely devastating disasters or war, communities may be destroyed, and people must resettle temporarily or permanently. The supports and functional capacities of these contexts appear to make a profound difference for children and their families.

School and other child-nurturing institutions. Among the most widely reported protective factors for children offered by communities in the aftermath of disaster, exclusive of survival needs, are functional schools, childcare facilities, and other safe environments for children to play and to learn (APA 2010, Betancourt & Khan 2008, Masten & Obradović 2008, Masten & Osofsky 2010, Osofsky et al. 2007). These institutions serve to reestablish routines in a child's life, may provide respite for parents, and also afford opportunities for peer interaction, constructive activities, connections to competent adults, leadership and agency experiences, etc. Prompt resumption of schooling was one of the most highly endorsed

postdisaster practices in a Delphi consensus study based on surveying leading humanitarian agencies that intervene in many crises worldwide (Ager et al. 2010). Staying in school was associated with improved prosocial attitudes and behaviors in the study of former child soldiers from Sierra Leone (Betancourt et al. 2010). Other aspects of the community context have been studied, though research remains very limited. Community acceptance was a key factor associated with better adjustment in former child soldiers from Sierra Leone (Betancourt et al. 2010) and Columbia (Cortes & Buchanan 2007).

INTERVENTION

Research on disaster effects and promotive or protective factors has many implications for intervention designs to protect children and youth and promote resilience. Intervention research, however, remains limited. Perhaps this is not surprising given that research on the effectiveness of interventions intended to help children and youth weather or recover from catastrophic adversities is notoriously challenging to implement. The scarcity of strong research on interventions to mitigate disaster effects has been noted by numerous reviewers and reports (e.g., APA 2010, Bonanno et al. 2010, Hobfoll et al. 2007, Jordans et al. 2009, Tol et al. 2010). The shortage of quality intervention evidence is particularly disappointing given the extensiveness of exposure among young people to devastating disasters and conflicts and also the extensiveness of humanitarian efforts to intervene and help. Peltonen & Punamäki (2010) recently found only four studies that met criteria for their meta-analysis of intervention studies in situations of terrorism or armed conflict.

Nevertheless, disasters continue to unfold, and stakeholders must take action to prepare and respond to disaster, informed by the best evidence and corresponding theory to date. Whether one is preparing for specific kinds of disaster or terrorism in high-risk-for-exposure zones or responding to an unexpected calamity, preparations and responses cannot wait for

complete scientific knowledge to accrue. For those who must act, there is a reassuringly strong consensus on broad guidelines for intervention. At the same time, it is clear that greater investment is needed in research infrastructure, methods, and collaborations in order to build a better evidence base going forward. In this section, we highlight examples of the best evidence on intervention for children or youth, describe the broad guidelines that reflect the current consensus, and comment on the importance of better data for future intervention efforts.

Exemplary Studies of Preventive Interventions and Treatments

Among the few studies meeting the gold-standard design feature of randomized assignment to intervention versus comparison or control groups (randomized controlled trial; RCT), several have been done in the former Yugoslavian countries in the aftermath of political violence and war in the region. One of the earliest of these studies, reported by Dybdahl (2001), conducted in the year following the end of the war, focused on mothers of young children ages 5 or 6 in Bosnian families who were exposed to severe war atrocities. Families were randomized to the intervention, which focused on warm and supportive interactions of mothers with children during a five-month group program, with treated families receiving medical care plus the intervention compared to a control group receiving only medical care. Intervention effects on mothers were reflected in better mental health outcomes in mothers and children as well as greater weight gain in children. Layne and colleagues (2008) also conducted an RCT in Bosnia, which focused on war-exposed adolescents with persistent symptoms and significant impairment several years following the cessation of hostilities. Students were randomly assigned to a classroom with psychoeducational and skill-focused intervention (only) or a classroom that also received a school-based trauma and grief-focused group treatment (manualized, 17-session therapy group). Both groups improved over time, although the latter, more

intensive treatment group showed greater reduction in maladaptive traumatic grief.

In one of the few studies in the literature testing a theory of change (mediators of treatment effects), Tol and colleagues (2010) examined the mediating role of hope, coping, and peer/emotional/play social support on treatment effects in an RCT study of children ages 8 to 13 in Indonesia who were exposed to political violence. The treatment, based on an ecological theory of resilience, was designed to foster creative expression of experiences with violence by utilizing cognitive-behavioral strategies in a classroom setting. Only peer social support was found to mediate the treatment effects of this manualized classroom intervention.

Efforts to prepare children for terrorism attacks or armed conflict (Ayalon 1983, Wolmer et al. 2011) or disasters (e.g., tornado drills) often combine simulations of the threat and training in adaptive responses. To date, evidence on natural or planned (attenuated) exposures to disaster as a vaccination-like preventive intervention is limited and primarily retrospective (Bonanno et al. 2010). A rare exception can be found in a recent report on stress inoculation training (SIT) in Israel, where a school-based SIT intervention was added to the school curriculum in multiple schools in a high-risk area for armed conflict. Three months following a three-week conflict ("Operation Cast Lead") with rocket attacks and high trauma exposure, children in six schools who received the intervention were compared with children in six schools who had not received it, matched for exposure levels (Wolmer et al. 2011). Results suggested that SIT had preventive effects on PTS and other symptoms of distress. Such results offer intriguing evidence that this kind of approach holds promise for future prevention experiments in areas with predictable high risk for severe adversity, either natural or related to chronic political conflict.

Consensus Guidelines

There are two kinds of consensus in the literature regarding interventions for young people in the context of disaster: systematic efforts to reach consensus guidelines (e.g., Ager et al. 2010, Hobfoll et al. 2007) and recommendations based on reviews of the literature that suggest strong agreement in the field (e.g., APA 2010; Bonanno et al. 2010; Jordans et al. 2009; La Greca & Silverman 2009; Masten & Obradović 2008; Masten & Osofsky 2010; Norris et al. 2002a,b, 2008; Peltonen & Punamäki 2010; Pine et al. 2005). Recommendations from both kinds of consensus are quite consistent and also highly congruent with a risk-and-resilience perspective. These recommendations tend to be broad and oriented to universal/community-level approaches, in part because the evidence base on which to make specific recommendations is so thin.

Consensus guidelines often focus on different phases of disaster, including predisaster preparation, immediate aftermath or crisis phase, and longer-term recovery periods. Bonanno et al. (2010) have recently questioned the value of immediate intervention, beyond the provision of basic tangible necessities (such as water, food, shelter, medicine, or money), information, and support to keep natural social units together or reunite them. There is little or no evidence that prophylactic efforts in the field immediately after disasters have positive effects, and such intrusions may disrupt naturally occurring recovery processes or undermine self-efficacy or community efficacy. For example, two of the best-known crisis interventions, critical incident stress debriefing and grief counseling, do not show positive effects and may have negative effects on traumatized populations (Bonanno et al. 2010, La Greca & Silverman 2009).

Psychological first aid (Ruzek et al. 2007), a much less intrusive form of crisis intervention, currently lacks strong evidence of effectiveness (Bonanno et al. 2010). However, psychological first aid is much more aligned with the broad recommendations of experts on the risk and resilience literature pertaining to disasters, war, and terrorism (cited throughout this review) and experts in related practice or humanitarian fields (e.g., Ager et al. 2010, Hobfoll et al. 2007).

Five broad intervention principles have been proposed for mass trauma based on the literature by Hobfoll et al. (2007): promote a sense of safety, promote calming, promote a sense of self- and collective efficacy, promote connectedness, and promote hope. These recommendations align well with the broad implications of the resilience literature in regard to protecting, supporting, or restoring the most fundamental adaptive systems believed to generate the capacity for resilience (Masten 2001, 2011).

After some time is allowed for natural recovery with broad supports to families and communities in disaster-affected areas, there is considerable support for evaluations to determine if additional help is indicated at the individual, family, or community level (Bonanno et al. 2010, Norris et al. 2008). Numerous investigators recommend screening for treatable problems when symptoms persist or develop among survivors, although it is unclear what the best timing and strategies are for screening or intervention.

There also is strong consensus that disaster or conflict readiness is important to protect children, youth, and families in the event of calamity (Masten & Obradović 2008, Masten & Osofsky 2010, NCCD 2010, Norris et al. 2008, Wolmer et al. 2011). Recommendations for preparedness include training first responders on the needs of children, recognizing that parents, childcare providers, and teachers also are first responders for children, having plans for reuniting children with families, and considering in advance the importance of protecting and restoring the natural protective systems for children as well as their normal routines of school and play.

Cautionary Note on Intervention

There is some consensus as well on cautions to consider in the design and implementation of interventions in the context of disaster, war, and terrorism (Bonanno et al. 2010, La Greca & Silverman 2009). As noted above, there are concerns about intervening at the wrong time, too intrusively, and with strategies that have little

basis in research or are even contraindicated by evidence. Moreover, it is important to consider the possibility that intervention may disrupt or undermine naturally occurring resilience and recovery processes. Additional concerns stem from the widely acknowledged risks of imposing culturally or developmentally inappropriate interventions.

CONCLUSIONS AND FUTURE DIRECTIONS

There are striking consistencies and gaps in the literature reviewed here on children and youth exposed to disasters and political violence. Much of the theory and research in the area is guided by a developmental resilience framework, pioneered more than four decades ago, that continues to advance in new directions. There is strong consensus on what matters in terms of both exposure factors and protective factors. Broad guidelines for preventive intervention and policies have emerged, yet there continues to be a marked shortage of intervention research on what works, for whom, and when in relation to meeting the needs of children and youth exposed to disasters and other mass exposures to extreme adversities.

A resilience framework, broadly defined, appears to work well for conceptualizing and summarizing the findings and their implications for intervention. The effects of disasters and mass violence on individual development can be described in relation to exposure dose or cumulative risks that pose significant threats or disturbances to individuals, families, or communities; resources or promotive factors required to counterbalance these threats or adversities; and moderators that exacerbate or ameliorate the consequences of the risks, often described as vulnerability and protective processes. The capacity for resilience in a given child will depend on a confluence of myriad factors, including the developmental status and capabilities of the child (developmental stage and human capital), capacities embedded in the child's relationships and community connections (social capital), and many other potential

adaptive systems. The complex processes of adaptation in the aftermath of disaster will depend on many interactions at multiple levels of function, such as biological, psychosocial, and epigenetic influences on development and risk.

There appear to be fundamental adaptive systems that afford much of the capacity for resilience in young individuals faced with disastrous situations. At the behavioral level of analysis, these core protections include supportive and effective caregiving (preferably by established attachment figures in a child's life), problem-solving systems, self-regulation and social-regulation systems, motivational/reward systems underlying self-efficacy, and hope and belief systems that convey a sense of meaning. These systems appear to promote a sense of safety and connectedness, perceived control and agency, regulation of arousal and behavior, and optimistic thinking required in diverse situations for adaptive responses to threats and disturbances in life. Adults in many capacities (parents, mentors, friends, neighbors, first responders, etc.) play crucial roles in the risks and resilience of children in disasters.

Major findings from rather disparate studies of children and youth in disasters and war align very well with resilience theory and the consensus recommendations from field experts. The implications of this body of work suggest that intervention efforts focus on protecting and restoring core human capacity for resilience in addition to mitigating risk and symptoms. A very limited body of empirical intervention research is consistent with the broad principles of intervention that have emerged from theory and basic research.

There is a stunning lack of evidence on intervention, given the scope of worldwide exposure of children and youth to disasters, terrorism, and war, and the likelihood of future exposures. The overall lack of research on interventions and their effectiveness has been noted in every relevant article included in this review. Addressing this profoundly important hole in the evidence base is the most important task for the future.

Informative research on what works to protect children and youth and to promote their resilience in the aftermath of mass disaster and trauma is challenging to execute, for all the reasons noted elsewhere in this review and in numerous other reviews. Yet it is also the case that there is a strong base of evidence and theory to inform intervention models of change. Masten (2011) has argued recently for a synthesis of basic and applied resilience frameworks, what she terms "translational synergy," to guide the needed research that aims to promote resilience in children threatened by extreme adversity. In this integrated model, intervention research is designed collaboratively by field and research experts working together, with the joint goal of fostering resilience in threatened individuals (intervention goals) while simultaneously testing theories of change (science goals).

Given that there are high-risk areas for exposure to natural disasters or political violence, there also is potential to test universal prevention and preparedness efforts. The controlled study by Wolmer et al. (2011) of a universal, teacher-based preventive intervention in Israeli schools provides a recent example. Recent research on military families and large-scale efforts to promote their resilience may also inform efforts to prepare civilian families living in high-risk zones for exposure to war (Saltzman et al. 2012). Studies that fully meet gold-standard design criteria of random assignment may be feasible as well.

It may be time for governmental agencies charged with disaster preparedness recovery to mobilize teams of experts to plan universal preventive experiments. Similar teams are needed to plan (design and secure advance funding) for postdisaster intervention studies that are low risk, ethical, and can be fielded quickly. Capitalizing on research already done or underway in disaster- or war-impacted areas by facilitating postdisaster research is also important (Furr et al. 2010, Masten & Osofsky 2010). In regions at risk for hurricanes, it may be a good investment to routinely survey normative development, behavior, symptoms,

and stress levels in schools, which could then serve as baseline, predisaster, or comparison data in the eventuality of disasters.

It is also clear that additional research is needed on methods and measures that work across diverse situations and cultures, in addition to measures suitable to specific situations (Furr et al. 2010, Masten & Osofsky 2010, Peltonen & Punamäki 2010). Measures are often invented or adapted "ad hoc" for disaster research because there are so few validated tools. Evidence can be difficult to aggregate in the absence of systematic and comparable assessments.

Finally, as noted by many scholars in this field, we need to pay more attention to developmental issues and most particularly to developmental timing and the longitudinal course of change following exposures. Development interacts with biological underpinnings of risk and a child's accumulated experience, and there are likely to be sensitive periods for trauma exposure as well as differentially effective interventions related to developmental status and intervention timing after exposure. There is very little information in the literature on long-term outcomes of disaster exposure, or what types of interventions might be most effective for whom and when, in terms of developmental timing or timing following exposure.

New Horizons

Although there are major gaps in the extant literature, most notably on intervention effectiveness, there also are exciting new directions in this research domain. Advances in neuroscience, genetics, and the analysis of complex systems at multiple levels are revolutionizing the study of risk and resilience (Cicchetti 2010, Feder et al. 2009, Sapienza & Masten 2011). There is rapid growth in the biology and neuroscience of resilience and, concomitantly, in the multiple-level study of disaster effects on development, in the short- and long-term and even across generations. There also is growing interest in more comprehensive studies of disaster that integrate models and knowledge across disciplines (Folke et al. 2010, Longstaff 2009, Masten & Obradović 2008). Mass-scale natural disasters and wars represent major disturbances of multiple, interdependent systems across scales from the molecular to the global and also across traditional science boundaries (ecology, psychology, emergency medicine, economics, etc.). Preparing for these extreme and complex situations and promoting recovery in their aftermath requires integrated sciences and strategies. Human development reflects the interplay of many systems across many levels, and eventually the science of human response to disaster must embrace this complex reality.

SUMMARY POINTS

1. Although research in the context of large-scale disasters poses major ethical and methodological challenges, there is notable progress in the quantity and quality of the evidence base over the past decade.

2. Risk and resilience frameworks continue to guide basic and translational research on the effects of extreme adversities in young people and their families.

3. Developmental timing of extreme adversity experiences has important implications for the nature of exposure, mediating and moderating processes, protective factors, future adaptive capacity, and design of interventions. The role of age in exposure and response is complex: Younger children are relatively protected in some ways and vulnerable in others in comparison to older youth.

4. There is growing interest and evidence related to the biological embedding of extreme stress in human development and increasingly plausible explanations of mediating processes that could explain its long-lasting effects on health and well-being, even across generations.

5. Research is needed to understand inoculation versus sensitization effects in response to repeated trauma exposure.

6. Given the striking shortage of data on intervention effectiveness despite pressing international need, research on pre- and postdisaster interventions to promote resilience in young people and families in mass trauma situations is a top priority.

7. Despite limitations in the evidence base, there is a strong consensus on broad guidelines for child-sensitive preparedness and response to disasters and political conflicts, based on theory, basic and applied research, and field experience. These guidelines include training of all disaster-response personnel on special needs and issues of children; recognition of parents, teachers, and care providers as first responders who also need training; avoiding separation of children from caregivers and reuniting separated families; careful monitoring of media exposure in children; and rapid restoration of routines, schools, and opportunities to play or socialize with peers.

8. Understanding and addressing the complexities of risk and resilience in human development under conditions of mass trauma require collaboration and greater integration of knowledge and methods across multiple systems and levels of analysis.

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