Resilience of children in disasters:
A multisystem perspective

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*I*nterest in resilience is surging in research, policy and practice as threats from disasters rise and humanity confronts a global pandemic. This commentary highlights the importance of defining resilience for portability across system levels and disciplines in order to integrate knowledge and prepare adequately for the challenges posed to children and youth by multisystem disasters. A scalable definition of resilience is recommended: The capacity of a dynamic system to adapt successfully to challenges that threaten the function, survival or development of the system. Major determinants of adaptation among young people in the context of disaster are highlighted, including variations in adversity exposure dose, developmental timing, individual differences and the socio-ecological systems of children's lives that can be mobilised in response. Adaptation of children in disasters depends on the resilience of interconnected systems, including families, schools, communities and policy sectors. Implications of a multisystem perspective for disaster risk reduction and preparedness are discussed with a focus on nurturing the resilience of children and their societies for challenges in the near term and long into the future.

Keywords: Risk; Protective; System; Socio-ecological; Surge capacity.

The future of children globally is threatened by rising natural, political and technological disasters (Masten, 2014). Resilience research and general interest in resilience have been surging along with the intensity of disasters in recent decades (Masten et al., 2015; Paton & Johnston, 2017). Then, in 2020, a pandemic spread across the globe, dramatically disrupting the lives of children and their families, as well as communities, economies and societies (Masten & Motti-Stefanidi, 2020; Walsh, 2020). Although disasters vary in a multitude of ways, they pose threats on a large scale to living systems. Disasters are multisystem in nature, demanding mobilisation and coordination of multiple adaptive systems in order to mount an adequate response. Integrating resilience science across disciplines and levels is critical to meeting the multisystem challenges of disasters. This commentary highlights past and potential future contributions of resilience science to this goal, with a focus on the interconnections of resilience in children to the resilience of families and other systems in disasters. First, the emergence of a multisystem perspective in resilience science is briefly highlighted, including a working definition of resilience. Second, challenges of integrating research on resilience are discussed, followed by a summary of "what matters" for adaptation of children in disasters. Two subsequent

sections delineate a resilience framework for disaster response and three basic strategies to promote adaptation in children and their families, including examples. The commentary concludes with broad implications of a multisystem resilience perspective for disaster preparation, response, and research focused on children.

EVOLUTION OF RESILIENCE THEORY IN THE BEHAVIOURAL SCIENCES

Resilience science emerged in psychology, psychiatry and related fields five decades ago as the result of efforts to understand, treat and prevent the development of psychopathology in children and youth (Luthar et al., 2015; Masten et al., 2021). Research on disaster has played a salient role in the ongoing evolution of resilience science (Masten et al., 2015). Early studies defined resilience in various ways, reflecting the capacity for, processes of or outcome of successful adaptation despite challenging or threatening circumstances (Masten et al., 1990). Over time, however, as the influence of systems theory grew in multiple fields of study, there was a shift towards defining resilience as a systems concept for portability across disciplines (Masten et al., 2021).

Beginning in 2005, a resilience network on "Building an Interdisciplinary Study of Resilience" (Longstaff, 2009) was funded by the National Science Foundation as part of their "human dynamics" initiative. This small network of investigators from disparate disciplines, including this author, focused on integrating theory and findings to improve disaster response to complex, multisystem disasters. It was soon clear that this formidable task required a better alignment of definitions and ideas in order to harmonise and assemble knowledge and practice from different research and intervention traditions. Success was facilitated by adopting a scenario approach, focusing on mass-trauma multisystem disasters, such as pandemics or hurricanes. Based on a symposium presented by network members at the first international conference on resilience ("Resilience 2008"; sponsored by the Swedish Academy of Sciences and the Resilience Alliance), the network published a set of articles in a special feature of *Ecology and Society* on "Managing Surprises in Complex Systems" (Masten & Obradović, 2008).

The compelling need to define resilience for multisector, multidisciplinary action converged with a rapidly growing groundswell in developmental science to embrace systems theory (Masten et al., 2021; Overton, 2013). Given converging goals and theory across disciplines, as well as the growing urgency of models for disaster preparedness and response, there are compelling reasons to support a general systems-oriented definition of resilience akin to the following (Masten, 2014, 2018): The capacity of a dynamic system to adapt successfully to challenges that threaten the function, survival or development of the system.

Resilience capacity often is inferred and judged on the basis of observable results—successful adaptation by specified criteria—arising from processes engaging that capacity (Masten & Cicchetti, 2016). Resilience is dynamic, always in flux, because the systems, processes and contexts involved are constantly changing through many interactions. Resilience is limited in the sense that the capacity available to respond to a given challenge can be depleted or overwhelmed. Although most powerful adaptive systems supporting human life and well-being have short-term "surge capacity" to boost adaptive response capability, these reserves can be drained. Fortunately, resilience can be renewed or replenished in key systems with rest or deliberate efforts to restore or build capacity. Theoretically, a complex adaptive system has potential capacity at multiple levels of functioning that can be activated or drawn upon in response to challenges. These vary from an immune system prepared to respond with antibodies to a social network of people available for emotional or practical support in an emergency.

Research on resilience encompasses the study of diverse systems that manifest the capacity to respond when challenged to return to a stable state of equilibrium, adjust to a new normal or transform in order to survive or flourish. There are literatures on resilience in individual people and animals, families, economies, artificial intelligence (AI) systems, communities, societies, healthcare systems, emergency response systems, organisations and ecosystems, cities and numerous other kinds of complex adaptive systems (Ungar, 2021).

The definition of resilience above is intended to be portable and scalable across system levels (molecular to macrosystem) and disciplines. It is consistent, for example, with the community-level definition of Norris et al. (2008) describing resilience as a network of adaptive capacities or, more precisely, as "*a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance*" (p. 130). It is compatible as well with definitions of resilience in ecology, illustrated by the definition on the Resilience Alliance website (2020, April 28), the "capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions," or by Folke's (2016) view of resilience in complex adaptive systems as "the capacity to persist in the face of change, to continue to develop with ever changing environments."

Major disasters challenge many systems simultaneously or in a cascading sequence as interconnected systems become overwhelmed. Acute shocks and trauma can trigger complex reactions at many system levels in a community as well as in an individual person. A hurricane or an earthquake, for example, can wreak destruction and death simultaneously on multiple levels, with consequences that may endure a lifetime. Moreover, disturbances at one level can disrupt function at another level, for example when a virus, such as COVID-19, not only causes debilitating illnesses in individuals but also has cascading effects that disrupt many aspects of family life, work-life, school function, healthcare, business, economic markets and the functions of governments and non-governmental organisations (NGOs). Chronic stress can cause wear and tear on the body that also may lead to profound changes in development or function over time (McEwen, 2020).

At the same time, threats to the function of a complex adaptive system also trigger responses at multiple levels that collectively serve to stabilise, protect or transform the system so it may survive, recover or continue in a new form. Effective responses at many levels also can boost resilience capacity with spreading effects (Masten & Cicchetti, 2016). Resilience science in many disciplines has focused on identifying how adaptive systems respond effectively to significant challenges and how that knowledge can be applied to improve the resilience of systems to future challenges. It is not surprising that disasters, which present widespread threats to large numbers of people and the systems they depend on for life and well-being, have

spurred scientists in diverse disciplines to integrate their ideas and knowledge on resilience, despite the difficulties inherent in this goal.

THE CHALLENGES OF INTEGRATING RESEARCH ON RESILIENCE IN DISASTERS

Differences in theoretical and operational definitions of resilience in the social sciences have led to extraordinary variation in methods and findings, opening up many avenues of important inquiry, but also creating significant challenges for systematic reviews of the literature. Inconsistencies and obstacles presented by varying definitions and empirical approaches in this literature were recognised early (Luthar et al., 2000) and continue despite advances in research methodologies (Masten & Cicchetti, 2016). In addition, due to variation in types of disasters studied, reviews on the effects of disaster on children and families often combine studies of distinctively different mass-trauma calamities. These include terror attacks, large-scale accidents (e.g. the sinking of a ferry), natural disasters, technological disasters and multifaceted disasters that combine a natural disaster with technological calamity or human errors and neglect, such as the Buffalo Creek disaster or the meltdown of the Fukushima Daiichi nuclear facility after the Tōhoku earthquake and tsunami (Masten et al., 2015).

As a result of these challenges, until recently there were few systematic reviews or meta-analyses in the disaster literature. One of the first, by Furr et al. (2010), included studies of terror events in their review of acute disaster studies but not chronic adversities such as war. Results of their meta-analysis aligned well with narrative reviews of the literature, indicating that children show post-traumatic stress symptoms (PTS) post-disaster, with girls showing more symptoms, and also corroborating widely observed dose effects, where indices of disaster severity or exposure (e.g. death toll of the disaster, personal loss) were linked to more PTS symptoms.

Systematic reviews of interventions for PTS related to disasters for children also have emerged, usually finding that psychological interventions, particularly cognitive behavioural therapy, reduce PTS across studies (Brown et al., 2017; Gutermann et al., 2016; Newman et al., 2014). Some studies suggested that older children benefit more from treatment. Nonetheless, heterogeneity of methods and findings continues to limit integration of intervention studies.

INFLUENCES ON HOW CHILDREN RESPOND TO DISASTER

Although the evidence on resilience in the context of disaster and related mass trauma experiences is diverse with varying concepts and measures, the general picture emerging from this literature has been reasonably consistent since the earliest narrative reviews. The parameters that "matter" for children and youth reflect the interplay of the following key components.

Dose

Generally, more extreme exposures to adversity (more intense, more prolonged, more cumulative trauma), have been associated with more problems and less favourable adaptation. In other words, dose gradients are observed (Masten et al., 2015). Greater exposure to destruction or violence, loss or injury, displacement or separation from the family, for example, is typically associated with more symptoms and disturbances in functioning.

General pre- and post-disaster context

Disaster unfolds in a complex context of ongoing individual life experiences, historical context and cultural meaning. The context—before, during and after exposure to disaster—appears to play many roles in the interpretation and response to disasters at multiple levels. An acute shock in the midst of ongoing, chronic adversity and poverty differs from an acute shock in a low adversity context. Exposure to the tsunami of 2004 in Sri Lanka had more effect overall for children who were already living in a war zone and/or experiencing family adversity (Catani et al., 2008). Qualities of the recovery context also influence adaptive functioning over time. When rebuilding is slow or other traumatic experiences ensue, as observed following Hurricanes Katrina and Maria, families and children may show more prolonged problems (Orengo-Aguayo et al., 2019; Osofsky et al., 2016). Disasters that destroy communities or separate children from classmates for long periods of time appear to have more lingering effects (Masten et al., 2015).

Marginalisation and inequality also play many roles in the vulnerability and resilience of children and families in disasters. Impoverished families often live in more hazard-prone areas and have less social and economic capital to mobilise for recovery (Aldrich, 2012; Norris et al., 2008). The COVID-19 pandemic has revealed an array of vulnerabilities among children of colour in the United States, ranging from higher odds of losing a parent or grandparent to the disease to greater food insecurity and lack of access to learning tools than their more advantaged peers when schools are closed (Ambrose, 2020). Disasters often reveal profound pre-existing inequalities in families, schools, communities and cities, observable in health disparities and differential rates of loss, displacement or recovery in the aftermath of disaster. Children already exposed to the adversities that accompany poverty and discrimination appear to be more vulnerable to the added stressors posed by disasters, directly through higher

exposure to adverse experiences pre- and post-disaster and indirectly through greater effects on their disadvantaged families, schools and communities.

Developmental timing

Dose of exposure as well as vulnerabilities and protections also vary by developmental timing of disasters (Masten et al., 2015). Age and accompanying developmental changes alter the likelihood of different exposures as well as the interpretation of experiences. Older children and adolescents have more contact with the world outside the family and greater awareness of what is happening. Families also perceive dangers to children of different ages differentially, depending on age and the capabilities of the individual child, as well as cultural expectations about the responsibilities or behaviours of children at different ages.

Vulnerabilities and protective resources of children also vary by developmental timing (Masten et al., 2015). Infants and toddlers depend on the quality of care and thus are highly vulnerable to loss of primary caregivers by separation or death. On the other hand, young children are readily comforted by attachment figures and protected by apprehending less about the scope of disasters and their long-term significance. Adolescents, in contrast, may be painfully aware of the significance to their lives both now and in the future of disaster damage or losses, and more vulnerable to disillusionment or despair than an infant would be. Compared to young children, however, adolescents are more independent and capable, with a broader circle of social support. Moreover, adolescents have more capacity to help during a disaster and thereby more opportunities to experience agency and self-efficacy through productive roles in disaster response or recovery.

As a result of these developmental differences, intervention strategies and planning for infants and adolescents would be expected to differ. For infants and young children, it is essential to have a caregiver that provides emotional security as well as reliable care. For adolescents, keys to intervention may involve opportunities for validation and participation in recovery, prosocial peer activities and meaningful involvement in important work for the community or their own futures.

There also is growing attention to biological differences related to developmental timing of trauma, both prenatally and over the life course. For example, research indicates that the timing during pregnancy of a disaster experienced by the mother may have differential effects on the developing foetus (Bowers & Yehuda, 2020; Masten & Cicchetti, 2016; O'Donnell & Meaney, 2017). Developmental timing effects in recent research are often examined in relation to developmental sensitivity and brain plasticity (McEwen, 2020). Physical harms that result from a disaster (including radiation, starvation or infection) may have differential effects on development depending on the timing and whether the effects occur during a sensitive period of development. Radiation effects, for example, vary during fetal development and also for individuals exposed at different postnatal ages; children generally are more developmentally vulnerable to radiation exposure than adults (Fushiki, 2013).

Individual differences

From the earliest reviews and studies, individual variation in the impact and recovery from disasters and similar severe adversities were noted (Garmezy, 1983; Masten et al., 1990). These variations often were attributed to individual vulnerabilities in susceptibility to adversity exposure or its effects on the individual or to the presence of protective aspects of personality, cognition, social–emotional skills or talents. Many lists of protective factors reported in the literature include individual differences in cognitive abilities (e.g. IQ, executive functions); self-regulation of emotion and behaviour; self-efficacy, agency or self-confidence; persistence; motivation to adapt; and optimism (Masten, 2018).

Sex differences also have been studied in diverse disasters, either as a risk factor or moderator of effects on children or youth (Furr et al., 2010; Masten et al., 2015). The most salient differences related to sex are the likelihood of more elevated internalising symptoms in females (trauma symptoms, depression, anxiety or other forms of distress) and more externalising symptoms in males, but the data are not fully consistent. Even when sex differences are found, they can be quite difficult to interpret (Masten et al., 2015). Sex differences can be confounded with the nature of exposures during disaster, response biases related to gender, and cultural expectations about male and female behaviour. Females generally report and are reported by others (teachers and parents) to manifest more internalising and less externalising behaviour than males. Females in many cultures are expected to show more distress and less anger and may be socialised to express distress accordingly. Moreover, the nature of exposures during disasters can differ, in part due to expected roles, and females may seek or receive different protections than males. Any combination of these factors could influence objective or perceived sex differences.

A rapidly growing area of individual differences research on resilience in the past two decades has been focused on neurobiological processes (Feder et al., 2019; Ioannidis et al., 2020; McEwen, 2020). It is too soon to characterise the findings, but the neurobiology of resilience is under intense study to elucidate biological and neural processes in adaptation to adversity. Much of this work was spurred by the advances in methodology and knowledge about brain function and development,

as well as epigenetic change, including the potential for social experiences to influence biological processes.

One provocative direction of this research has focused on the hypothesis of "differential susceptibility" (Ellis et al., 2011) or "biological sensitivity to context" (Obradović et al., 2010). The idea of variable sensitivity in how individuals respond to experiences, positive as well as adverse, underscores the interplay of context with individual differences in vulnerability and resilience. In the context of disaster, children with biological sensitivity could be more vulnerable to adversity but also more protected by the actions of effective parents and more likely to benefit from interventions.

Family resources and resilience

The importance of family resources and protections for resilience in children has been noted from the earliest period of resilience science for a wide range of adversities, including disasters (Garmezy, 1983). Close relationships with caregivers and effective parenting by caregivers typically top the list of key protective factors identified in studies of resilience as well as reviews and commentaries in the literature on resilience in children (Luthar et al., 2015; Masten, 2014). Concomitantly, the most widely studied interventions to promote or support resilience in children are focused on bolstering the quality of parenting (Masten & Cicchetti, 2016; Sandler et al., 2011).

The capacity of a parent to function as a protective factor clearly depends on the resilience of that person, yet attention to the processes linking parent or family resilience with child resilience—conceptualised as a multiple-levels, multisystem set of processes—was not given the attention it warranted until quite recently (Luthar & Eisenberg, 2017; Masten, 2018). In earlier years, theory and research linking family or parent resilience to child resilience were most prevalent in research on disadvantaged families (Egeland et al., 1993). Now, theory and research on family resilience, child resilience and the processes that connect them, including parenting, are the focus of broad integration (Doty et al., 2017; Masten, 2018).

The central role of resilience of parents and families for children also has been widely observed in the literature on disasters, including recent commentaries on COVID-19 (Gewirtz et al., 2008; Masten et al., 2015; Masten & Motti-Stefanidi, 2020; Walsh, 2020). Clinical observers and humanitarian workers long have noted the profound effects on children of separations and loss of family and caregiving in the midst of disasters as well as war and conflict. There also is growing interest in the processes (genetic, epigenetic, neurobiological and social) by which intergenerational transmission of trauma related to disasters may occur (Bowers & Yehuda, 2020).

School resources and resilience

Schools play a central role in the development of children in many communities around the world, so it is not surprising that schools symbolise normal life, for community members as well as children and their parents. Schools, like families, play a dual role in child resilience: they provide a host of resources and relationships that support child resilience directly and they also *nurture* resilience (Masten et al., 2021; Ungar et al., 2019). Effective schools have qualities that parallel effective families (Masten, 2018), such as strong leadership; caring relationships; collective pride and a sense of belonging for students; positive routines; good communication and opportunities to learn new skills. In the context of effective schools, children develop tools for life that bolster their future resilience capacity, including problem-solving skills, social skills, self-confidence, self-regulation, motivation to learn, critical thinking, how and when to get help, etc.

As a result, schools also play essential roles in disaster risk, preparation and resilience (Lai et al., 2016). Disaster management and planning at state, national and international levels have increasingly focused on emergency planning and safe learning environments for school children in the context of disaster. There is growing recognition that schools are essential not only for children but also for their families and communities.

Disasters that damage schools and harm children, teachers and/or leaders in those schools, pose potentially traumatic experiences for children. When school shuts down for prolonged periods, there can be profound and widespread effects, not just on individuals who are directly affected, but on the whole family, community and economy. This issue was widely noted after Hurricane Katrina, which closed schools in some areas of New Orleans for extended periods (Osofsky et al., 2018). Similarly, safe reopening of schools rapidly became a vital concern in countries around the world during the COVID-19 pandemic.

Programs that engage students to lead in school or community recovery appear to have multifaceted salutary effects on recovery after disasters. Students in the Youth Leadership Program implemented in the St. Bernard United School District after Katrina, who were engaged in meaningful recovery projects for their school and community, gained self-efficacy and showed fewer trauma symptoms over time (Osofsky et al., 2018).

Many of the interventions to promote resilience in children exposed to war or terror, as well as disaster, have been implemented in school contexts (Lai et al., 2016; Masten et al., 2015). Schools offer compelling advantages for interventions, not only because children are already connected to schools, but also because programs in school contexts appear to be perceived as more normative, less stigmatising and more acceptable to parents and students alike.

Community resources and resilience

Children depend on the resilience of families and schools, but also the systems in which these microsystems of development are embedded. Communities provide social, economic and human capital to support children and families (Luthar & Eisenberg, 2017; Masten & Motti-Stefanidi, 2020). These resources for families and schools include health and emergency services, the first responders to deliver those services; leadership; supports for vulnerable members of the community; operational systems for the sewer, electricity, clean water and many other services related to maintaining community order, supporting the education of children, etc. Communities also provide supports for religious organisations and practices as well as community routines and celebrations.

Much like families and schools, communities large or small can provide strong leadership, a sense of pride and belonging (e.g. "Boston Strong" after the Marathon bombing in that city) and support the systems that in turn support children in many ways. The Search Institute in Minneapolis, Minnesota, developed a measure for community surveys of "40 Developmental Assets" for young people that included individual, family and community resources. Community assets included *caring neighbourhood* ("young person experiences caring neighbors" and *community values youth* ("young person perceives that adults in the community value youth" (Benson et al., 2011, p. 199).

Because disaster risk reduction often occurs at the level of communities, there is growing recognition of the importance for communities to plan for the resilience of children in disaster response. The Sendai Framework, for example, called for involving children in planning for disaster risk reduction (United Nations International Strategy for Disaster Reduction [UNISDR], 2015). The published summary of a workshop on disaster preparation organised by the U. S. National Academies (Forum on Medical and Public Health Preparedness for Catastrophic Events, 2014) highlighted the special needs of children and offered many recommendations for strengthening national readiness at the community level to manage disasters in ways sensitive to children. These recommendations ranged from ensuring that emergency transport and equipment fit the needs of children to childcare after disaster.

Societal and other higher-level supports for child and family resilience

The Sendai Framework also reflects the role of higher system levels in disaster risk reduction for children. Many systems beyond the community (e.g. states, federal government, humanitarian and religious organisations) that are more distal to individual children and families play a crucial role in resilience. These macrosystems influence the resilience of children in many indirect ways by setting policies and priorities for disaster risk reduction and preparation. In the event of actual, large-scale disasters, these distal systems become more directly influential through mobilising to meet the challenges of disasters that require a coordinated response beyond the scope of community or even state resources. Much of the surge capacity required by major disasters is embedded in higher-level networks of resources and social capital that can be mobilised and redistributed to an area that requires large scale disaster relief (Aldrich, 2012).

Coordinating multisystem and multisector resources and adaptive processes can be as much or more of a challenge than having the structural capacity or physical resources. Emergency management preparation focuses intensively on logistics and coordination of strategies and expertise due to their vital roles in successful disaster response (Danese et al., 2020).

It is also important to note that many daily routines at multiple system levels are facilitated by access to electricity and the internet, which are now essential for many aspects of human life. As a result, restoring power is a multifaceted strategy for disaster response that is fundamental not only to communication, heat or air conditioning, medical equipment and computers, but also to many of the social and educational systems supported by computers and smartphones that require power to continue operating. Concomitantly, electrical power and internet connections began to symbolise a return to "normal" even when it is actually a "new normal." Human resilience depends in key ways on "grid resilience" (Jufri et al., 2019) and already, we are moving to dependence on the resilience of the local and global internet systems that also rely on the resilience of power systems. Social capital as well as physical resource allocation, supply chains and transportation have become highly dependent on computers, the internet and electrical power (Aldrich, 2012). The need for distance learning and social distancing during the COVID-19 pandemic underscored the vital importance of resilience in power grids for the well-being of children and adults.

A RESILIENCE FRAMEWORK FOR DISASTER PREPARATION AND RESPONSE

A multisystem view of resilience, whether defined as the capacity of a single individual, a family or an entire community to respond effectively to disaster, has numerous implications for disaster preparation and response. There are going to be multiple strategies and systems that could be considered with the likelihood that many systems can contribute to resilience if they are prepared and coordinated optimally.

From a child's perspective, resilience in a disaster will depend on resilience of numerous other systems that already play or begin to play key roles in that child's life, directly or indirectly. Under most circumstances, the resilience of the child's family will be critically important and young children are particularly vulnerable to loss of caregiving. Supporting the resilience of parents and families during and following disasters is of paramount importance to children, along with survival needs and reuniting the family.

Beyond the family, the function of childcare systems and schools during the disaster and recovery period also play a salient role in children's lives in multifaceted ways. Children need opportunities to play, socialise with peers and learn, and working parents need to know their children are safe, well cared for and returning to the developmental tasks of childhood. Older children need opportunities to connect with their peers beyond the home and classroom as soon as feasible. Moreover, given that older children understand the implications of disasters for their near and longer-term futures, it is important to restore hope and pathways toward future goals.

Symbols of rebuilding "normal" are important. Visible signs of restoring power, cleaning up, supplies arriving, home rebuilding and stores re-opening are important. Restoring internet services, day care and schools, grocery delivery and community services, even in the form of makeshift tents or other temporary forms, can provide a powerful sense of recovery and hope. Celebrations with cultural meaning also serve as important symbols of recovery.

Nonetheless, while restoring opportunities to learn, work and play can serve as powerful symbols of recovery, some caution also is in order. Hidden dangers can undermine the benefits of normalisation. In the case of a pandemic, there can be risks of exposure. In wars, there can be the risks posed by landmines still in the ground or other remnants of conflict. In these situations, benefits and risks must be considered along with timing.

THREE FUNDAMENTAL STRATEGIES FOR PROMOTING RESILIENCE IN DISASTER

Resilience research has suggested three major strategies for promoting better adaptation of children and their families in the context of significant threats, focused on risk, assets and adaptive systems (Masten et al., 2021). Table 1 provides examples of strategies implicated by disaster research (Masten et al., 2015). However, there are many other ways to engage the power of human adaptive systems and these strategies must be tailored not only to the nature of the challenges but also to the historical and cultural contexts of the affected populations.

TABLE 1
Risk-focused, asset-focused and adaptive-system-focused strategies for promoting positive adaptation of children and their families in disasters: examples

Risk	Goal: Prevent exposure or mitigate ongoing effects of adversity
	Emergency planning for vulnerable children with distinct needs
	Equip and train for meeting unique medical needs of children
	Practice safety and evacuation in schools, families and communities
	Build or fortify shelters, homes and schools for likely local disasters
	Limit media exposure to frightening news and images
Assets	Goal: Boost resources or access to resources
	Educate parents and teachers on needs of children in disasters
	Provide supplies essential to caring for specific daily needs of children
	Ensure that families have a place to call home
	Provide equipment and spaces for children to play
	Provide access to teachers, internet, computers and educational supplies
Adaptive systems	Goal: Mobilise, restore or facilitate powerful resilience drivers
	Reunite families; provide caregivers for unaccompanied children
	Support families so they can restore their normal routines
	Restore functioning of schools and childcare systems
	Restore and support meaningful cultural practices and celebrations
	Provide ways for young people to help with recovery

Risk-focused strategies are aimed at preventing adversity or threats from happening or risk mitigation. Classic examples include preventing premature birth through prenatal care or digging up landmines before building a school after a conflict ends. Risk prevention and mitigation includes efforts to train parents and teachers about limiting media exposure of children to death and destruction, efforts to fortify buildings against damage from earthquakes or storms, practicing evacuation drills and testing warning systems. Public safety efforts to reduce risk of exposure in an epidemic include social distancing, wearing masks and washing hands. Emergency planning that takes into account the needs of vulnerable populations, such as children with disabilities, also can mitigate risk (Danese et al., 2020; Peek & Stough, 2010; UNISDR, 2015).

Strategies focused on assets and resources also can take many forms, ranging from educating parents, teachers and traditional first responders about the needs of children in disasters to planning for rapid availability

of childcare essentials. In pending and cascading disasters, it is crucial to anticipate and position essential resources, such as water, shelter, medical supplies and food, including infant childcare necessities such as formula or diapers. For older children, it is important to consider resources for learning, play and social life, including internet connections, child-friendly spaces and schools. Family and school preparations for disaster often include both emergency plans and "go bags" with essential survival gear suitable to the location and the age of the child.

Knowledgeable responders prepared by trauma- and resilience-informed training represent an invaluable resource for children in disasters. Many states and regions now have teams of "all hazards" responders trained to deploy quickly in disasters, with ongoing education. In the United States, the National Child Traumatic Stress Network provides disaster training at the national and regional levels with funding from the Federal government. In addition, however, given the likelihood that parents and educators will serve as first responders for children and students in disasters, reports have underscored the importance of broad education about the needs of children in disasters and strategies to support their resilience (Masten et al., 2015). Training is important in regard to the needs of children of different ages, both for typically-developing children and those with vulnerabilities or disabilities.

The third major strategy is mobilising or restoring the powerful engines of resilience embedded in interconnected systems that have been implicated repeatedly in the literature as protective systems for children and families (Luthar et al., 2015; Masten, 2014). These adaptive/protective systems are anchored in supportive relationships and social systems (social capital), as well as individual brainpower and adaptive systems of the human mind (human capital). Important engines of resilience that can be mobilised and translated into protective and collective action in the context of disasters include problem-solving and ingenuity; motivation to overcome challenges; a sense of purpose and hope and supportive relationships, a sense of belonging, and leadership at many levels, from individual and family systems to communities and societies. These psychosocial adaptive systems operate in conjunction with internal neurobiological adaptive systems such as stress-regulation and immune system functions in the human body and many external sociocultural systems. Vaccination can mobilise individual immune systems to develop protection against specific threats, such as COVID-19. However, countering a pandemic caused by a novel virus requires complex, coordinated efforts to create safe and effective vaccines, manufacture and distribute them on a massive scale and motivate diverse populations to be vaccinated in order to boost collective immunity.

CONCLUSIONS

What are the implications of a developmental resilience-oriented approach to disaster preparation and response before and after disaster occurs? First and foremost, resilience of children, youth, families, communities, societies and ecosystems are interconnected. The capacity of children to respond to the challenges of disasters hinge in large part on how well their families are doing and how well the community is supporting the individuals, families and systems encompassed by the community system as a whole. Families living in poverty with little support in the form of nutrition and healthcare may have high levels of allostatic load that impair immune system function in members of the family (McEwen, 2020).

The community in turn depends on other, more distal macrosystems for its capacity. Some societies and communities have more healthcare capacity, better trained first responders and more emergency response resources. These systems also are embedded in socio-ecological contexts that have many influences on the nature of risks, vulnerabilities, resources and protective conditions at hand when disaster strikes. Low-lying homes near waterways that surge in storms pose considerable vulnerability to hurricane damage. Densely populated urban areas are vulnerable to epidemics.

Before disasters occur, there are many actions that can be taken at the family or community levels to mitigate the impact of likely hazards and build resilience capacity for children and families (Masten et al., 2015). Examples include the following: develop emergency plans that consider threats and protections from a developmental perspective; train teams of multidisciplinary first responders who can collaborate and also train others in an emergency; create basic guides and tips ready to go for likely disasters; invest in equitable health care systems for children and families; nurture human resilience in schools at all levels of education; build responder resilience through training and practice; reduce risk and trauma exposure in the everyday lives of children and families; build surge capacity for expected challenges and, make plans to protect or restore fundamental adaptive systems for children and families following disaster.

After a disaster begins to unfold, a resilience perspective suggests additional actions: Reduce additional trauma and re-traumatising for the population affected, including media exposure; activate trained all-hazard teams; restore basic resources and access to resources; protect, restore, mobilise and support basic human resilience systems at multiple levels; normalise daily life as it becomes possible and, provide age-appropriate opportunities for control, decision-making, restoring meaning, mastery, self-efficacy and contributing to recovery.

Positive adaptation in the context of large-scale disasters requires the effective engagement and mobilisation of

large-scale resilience capacity in many forms and ways, drawing on resilience distributed across many interconnected systems through many processes. Children, families and communities are all complex adaptive systems that are constantly changing and developing. The nature of the threats posed by large disasters matter, as do the resources at hand, but human social-ecological systems have evolved complex adaptive resilience capacities that can be mobilised and coordinated to respond to catastrophic challenges that upend everyday life and threaten survival of many human systems.

Research concepts, measures and studies are developing and improving gradually as research on resilience in disasters accumulates. While there is much yet to learn, clearly there is progress in understanding resilience, how it is nurtured at multiple system levels, how it develops in individual children, families or communities and how it is tapped, mobilised or expanded during disasters to protect the function, survival and future development of these systems. Learning and applying what we need to know to prepare for expected and unexpected shocks of the 21st century is going to require extensive networks of stakeholders representing many sectors and levels. It is essential that we integrate evidence and knowhow, which will require goals, funding, training for collaboration and leadership. Expertise in many disciplines is required to mobilise the potential of human individuals and organisations for resilience, whether before, during or after disasters emerge. Moreover, it is important to recognise that communication, harmonising goals, commitment, cooperation and leadership are also essential to mobilising and successfully applying resilience capacity to the benefit of children, families and communities.

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