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Resilience in Developmental Systems

Principles, Pathways, and Protective Processes in Research and Practice

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Introduction

Research explicitly focused on resilience in human development emerged in the 1970s as pioneering investigators noted the striking variation in adaptive function and outcomes of children identified as high-risk for mental health problems due to their circumstances or experiences (Masten, 2014b). Initially, the research was largely descriptive, as scholars charted patterns of healthy adjustment among children at risk for a wide variety of reasons, including maltreatment, genetic risk (e.g., born to parents with mental disorders), poverty, family conflict, or a combination of multiple known risk factors associated with elevated probabilities of undesirable outcomes (Masten, 2007). Nonetheless, these early investigators were searching for answers to a fundamental question: What makes a difference? In other words, how do we account for the positive life course of some children in the context of exposure to risks or severe adversity? The ultimate goal of answering this question was translational, to inform practice and policy that would prevent problems from arising or support positive development despite the presence of hazardous circumstances.

This chapter highlights the meaning and findings of developmental resilience science, particularly in regard to children and families. Following a brief history on the emergence of resilience research, this chapter presents an overview of the current meaning of resilience in studies of children and families and the developmental systems principles that inform that definition. Key concepts and models that guide this research are described and illustrated by empirical results. Implications of a developmental resilience framework for practice

Ann S. Masten, *Resilience in Developmental Systems* In: *Multisystemic Resilience*. Edited by: Michael Ungar, Oxford University Press (2021). © Oxford University Press. DOI: 10.1093/oso/9780190095888.003.0007

and policy are delineated, with illustrations from research on children at risk due to poverty, homelessness, or forced migration from the violence and chaos of political conflict. The chapter concludes with a discussion of new horizons in developmental research on resilience.

The study of development in the lives of children threatened by negative life experiences was influenced by streams of theory and empirical research in multiple fields of study concerned with normative human and mammalian development, the biology and psychology of stress, the origins of competence and psychopathology in childhood, and human responses to extreme adversity observed in children exposed to violence in families or trauma on the scale of war (Garmezy & Rutter, 1983; Masten, 2014a). It is notable that leading pioneers in the study of resilience in medicine and the social sciences were themselves often survivors of World War II, including Garmezy, Rutter, and Werner (Masten, 2014b). This devastating global conflict gave rise to theory, research, and interventions focused on understanding and mitigating the impact of trauma on child development.

Early research on resilience in children focused on identifying factors associated with better outcomes in children at risk and later research focused on explaining why those factors seemed to matter, shifting attention from "what matters" to "how" questions about the processes involved in resilience. These were the first two waves of resilience science in the behavioral sciences (Masten, 2007, 2014b). Once investigators identified key processes associated with resilience, interventions research ensued to test the causal role of these processes, representing the third wave. We are now in the midst of the fourth wave as scholars tackle multisystem questions and attempt to integrate concepts and findings about resilience across disciplines and levels of analysis.

During the initial decades of research on resilience in children, definitions of the concept varied in their emphasis on the observable patterns of manifested resilience ("doing well despite adversity"), the individual, relational, or sociocultural differences associated with better adjustment in risky conditions (often described as protective factors, assets, or promotive factors), and the processes involved in adapting or coping with the challenges of risk or adversity. Thus, in an early review, my colleagues and I noted that "resilience refers to the process of, capacity for, or outcome of successful adaption despite challenging or threatening circumstance" (Masten, Best, & Garmezy, 1990, p. 426).

As the early research on resilience was emerging, a broad revolution in developmental theory was unfolding, often described as developmental systems theory or relational developmental systems theory (Lerner, 2006; Osher, Cantor, Berg, Steyer, & Rose, 2018; Overton, 2013). This movement integrated theory in multiple disciplines focused on development in living systems, ranging from embryology (e.g., Gottlieb, 2007; Lickliter, 2013) and behavioral genetics (Gottesman & Hanson, 2005) to family systems (Henry, Morris, & Harrist, 2015; Walsh, 2016) and ecological models (e.g., Bronfenbrenner & Morris, 1998). This perspective integrated disparate theory on the roles of multiple interacting systems at multiple levels of analysis in shaping the development of living systems, including the development of children (Masten & Cicchetti, 2016). Zelazo (2013) described the growing prominence of systems theory in developmental psychology as the "new synthesis."

For resilience science, however, the emergence of developmental systems theory as the most prominent unifying theory in developmental science represented only part of the

impetus to shift toward a full-blown systems approach. Entirely consistent with the practical focus of resilience science, the other major influence that motivated a powerful shift toward systems theory arose from the growing threat of mass-trauma global adversities in the form of terror attacks, disasters, and pandemics (Masten, Narayan, Silverman, & Osofsky, 2015).

Mass-trauma adversities always played a role in resilience research, beginning with the pioneers, who highlighted observations about the effects of war and disaster on children in addition to the more everyday stressors of family violence, poverty, or oppression (Garmezy, 1983; Masten et al., 1990). Subsequently, a series of mass-casualty events elevated awareness of threats posed by large-scale calamities, such as domestic and international terrorism (e.g., Oklahoma City, 9/11), natural disasters (Hurricane Katrina, the 2004 tsunami in the Indian Ocean), and pandemics (e.g., Ebola, HIV/AIDS). Simultaneously, the number of children threatened by armed conflict also was growing internationally, generating huge numbers of displaced children and refugees (Masten et al., 2015). Concerns also were growing about climate change, as the frequency or intensity of storms and floods appeared to grow (Stott, 2016).

In April 2008, the Resilience Alliance and the Royal Swedish Academy of Sciences hosted a conference on resilience, Resilience 2008, which featured not only numerous presentations on climate change but also a symposium on interdisciplinary perspectives on resilience and natural disasters. This symposium highlighted the work of a research network, including this author, on "Building an Interdisciplinary Study of Resilience," funded by the National Science Foundation under its Human and Social Dynamics Initiative (Masten & Obradović, 2008; NSF 0524157). Our work was subsequently published as a special feature in the journal of the Resilience Alliance, *Ecology and Society*, "Managing Surprises in Complex Systems," edited by Lance Gunderson and Pat Longstaff. Our small network of five senior and five junior investigators met with the goal of integrating perspectives on resilience. As we met to discuss different definitions of resilience in disparate fields (e.g., ecology, human development, and computer science), we found it was easier to communicate and advance our agenda when we focused on the real issues posed by disasters and related mass-trauma calamities. Preparing for and responding to disasters, when many interconnected systems essential to human life collapse or stop functioning at the same time, made it abundantly clear that a multisystem approach was essential.

This interdisciplinary network experience underscored my belief that we needed a common and scalable language to facilitate integration of the many sciences engaged in research on resilience. My own shift to emphasize a systems approach to resilience was accelerated by this experience (Masten, 2007; Masten & Obradović, 2008).

Definition of Resilience from a Developmental Systems Perspective

From a developmental systems perspective, resilience can be defined as the capacity of a dynamic system to adapt successfully to challenges that threaten the function, survival, or

development of the system (Masten, 2011, 2014a, 2014b, 2018a). This definition is intended to be scalable across system levels from micro- to macrolevels and also across diverse disciplines. Resilience is relevant to understanding many kinds of complex adaptive systems, including a whole person the immune system within a person, a family, an economy, a business organization or a school, a community or a society, and many dynamic ecosystems across the planet.

The capacity of a complex adaptive system, such as a living person, to respond well to challenges is dynamic because the sources of that capacity are also dynamic and distributed across many interacting systems. Moreover, living systems develop and change over the life course in ways that influence their adaptive capacity. Problem-solving capacities generally expand with development and learning experiences until the organism begins to decline with age. However, at any given time, capacity can be affected by temporary situations, such as illness or overload.

Resilience in a person will reflect important general principles of development drawn from developmental systems theory (Masten & Cicchetti, 2016). Human development arises from the interactions of an individual's genetic inheritance (DNA plus any other heritable epigenetic marks) with many other interacting systems at multiple levels over time (Gottlieb, 2007). A human individual is embedded in other systems, such as a family and later a school, which in turn are embedded in higher order systems, such as a community). The great contribution of Bronfenbrenner's ecological theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 1998) to developmental science was highlighting the role of context in the form of these other systems in the development of individuals. A child interacts directly with microsystems such as the family or a set of friends or a team and indirectly with many other systems external to these proximal systems, such as a parent's workplace (an exosystem) or large, distal macrosystems that influence a child or her microsystems indirectly, such as a state government.

Within the individual child there also are many interacting systems at multiple levels, including an immune system, neural systems that support many other adaptive systems, and neuroendocrine systems that regulate arousal and stress responses. Child development also is influenced by a microbiome of non-human organisms that inhabit and surround the individual child (Cho & Blaser, 2012). All of these systems develop as the individual develops, continually influenced by interactions with the "external" context, beginning in the womb and continuing after birth. Development emerges from a complex network of interacting systems that also shape the capacity of the person to adapt to adversity.

The following principles stem from a developmental systems perspective on resilience (adapted from Masten & Cicchetti, 2016):

1. Many interacting systems shape the development of resilience in a living system.
2. Living systems are self-organizing with higher-order emergent capabilities that can be surprising or unpredictable based on knowledge from lower levels of analysis.
3. Resilience develops and changes because all of the systems accounting for resilience are dynamic; thus, human resilience develops and changes as a person develops and changes.

4. The capacity for adapting to challenging circumstances (resilience) depends on many interconnected systems.
5. The capacity for adaptation can be conceptualized at multiple levels.
6. The resilience of an individual extends beyond the individual organism through interactions and connections to other systems.
7. Adaptation of a complex system, such as a person, to major disturbances can take multiple forms: returning to equilibrium through self-stabilizing or external co-regulatory systems, breaking down to lower levels of function, death, or transformation.
8. Human resilience is shaped by the legacy of biological and cultural evolution through the evolution of many systems in the natural and built world and also by individual development.

It follows from these principles that the resilience of an individual child at any given time depends on other systems, and indeed on the resilience of other systems, both within and external to the child, and most especially in relationships and proximal systems, such as the family, school, peer groups, community, and culture. It also follows from these principles that no singular trait could account for resilience. Resilience is not a trait, although many attributes of the individual person many contribute to resilience.

Because so many unique interactions shape the development of a human individual and no two people (even identical twins with the same DNA) can have the same experiences, development is probabilistic and the life course of a person is often described as a *pathway*. The pathways of twins and children in the same family can diverge quite dramatically, and the pathways of two individuals from very different backgrounds can converge if their experiences shape them toward similar directions or outcomes. These possibilities are known as multifinality and equifinality in the developmental literature (Cicchetti & Rogosch, 1996). Trauma exposure can contribute to diverging pathways, particularly when individuals differ in their resilience to adapt to the trauma.

Typically we infer resilience capacity from observed pathways of *manifested resilience*. Manifested resilience refers to observable "good adaptation" in the context of adversity, by whatever criteria are being applied to evaluate the success of meeting a significant challenge. It has been noted for decades of resilience research that manifested resilience requires two fundamental judgments: (a) that there has been a significant challenge or disturbance of some kind that threatens the function of the person and (b) that the person is doing okay by meaningful adaptive criteria (Luthar, 2006; Masten, 2001). These criteria are discussed further later in the chapter. The goal of identifying manifested resilience typically is to advance the search for processes that made it possible for the system to adapt. In other words, it is important to distinguish manifested resilience from the resilience processes that made it possible for the person or other system of interest to adapt to serious challenges.

It was a logical starting point in the early research on resilience to begin the search for resilience by studying individuals who had demonstrated by their successful adaptation to adversity that they had the capacity to cope with or overcome in as yet unknown ways the challenges posed by negative life experiences. The resilience research pioneers hoped that by studying naturally occurring manifested resilience they could identify the resilience factors

and processes that accounted for good outcomes under challenging circumstances. Armed with that knowledge, the ultimate goal was to foster better development among children at risk due to adversity by informing interventions to promote resilience.

Key Concepts and Models in Developmental Resilience Science

Three central questions inform the purpose and design of resilience research in systems:

- What are the challenges confronting the system? (What are the risks?)
- How well is the system doing? (What are the criteria for adaptive success?)
- What processes support the adaptive success of the system?

Studies of resilience in human individuals have spanned a wide variety of challenges and adaptive criteria over the years, encompassing a large body of evidence pertinent to resilience in children and youth (see Goldstein & Brooks, 2013; Luthar, 2006; Masten, 2014b), resilience in adults (see Reich, Zautra, & Hall, 2010; Southwick & Charney, 2018), and resilience in families (e.g., Walsh, 2016). There are bodies of literature on specific hazards, such as divorce, death of a parent, or sexual abuse (Garmezy & Rutter, 1983; Masten & Cicchetti, 2016), as well as research on cumulative risk factors or threats, such as studies of adverse childhood experiences (Felitti et al., 1998) and studies of children growing up in poverty or disadvantage characterized by a multiplicity of hazards (e.g., Evans, Li, & Whipple, 2013; Maholmes, 2014). Now, scholarship on the disastrous cascading effects of the global COVID-19 pandemic is beginning to emerge (e.g., Masten & Motti-Sefanidi, 2020).

Criteria for evaluating how well a person is doing have also varied in the resilience literature on children and youth. Developmental researchers often focus on developmental tasks or the expected achievements for children of a given age, culture, and period in history (Masten & Coatsworth, 1998; Masten, 2014b). In modern societies across the world, for example, young children are expected to form attachment bonds to their caregivers and to learn to walk and speak the language of the family, and older children are expected to go to school, learn to read, get along with other people, and follow the rules of the family, classroom, and community. Trauma researchers often have focused on mental health symptoms as their criteria for (not) doing well while other investigators have focused on psychological well-being or happiness. As in the case with risk factors, some investigators focus on a specific criterion of adaptive success (e.g., work success or academic achievement), while others have a broader view of doing well that encompasses multiple indicators (e.g., Masten et al., 1999; Werner & Smith, 2001).

Many resilience factors and processes also have been investigated in answer to the third question, which is directly focused on resilience. These factors, or the processes believed to underlie them, have been divided into two basic groups: *promotive factors or processes* that are associated with better functioning on the criteria for judging adaptive function across risk levels (a main effect) and *protective factors or processes* that are associated with better

function or outcomes when threat levels are higher than normal (a moderating effect). Promotive and protective influences vary by situation (Masten & Cicchetti, 2016).

Some of these resilience predictors are very common across diverse situations, perhaps because they reflect very fundamental human adaptive systems and capabilities. From the outset of resilience research, for example, it was clear that the quality of caregiving and support from other attachment relationships played a central role in the resilience of children, as did the individual capabilities of the children, such as problem-solving skills. Other factors and processes were less common or relatively unique to a given culture or situation. Examples include ceremonial forgiveness rituals practiced by a particular community or practice drills at schools for fires, tornadoes, or other threats to school safety common in the regional context. In their article on rethinking resilience from Indigenous perspectives, Kirmayer and colleagues describe a ritual of reconciliation and forgiveness practiced by the Mi'kmaq people of Atlantic Canada (Kirmayer, Dandeneau, Marshall, Phillips, & Williamson, 2011).

Resilience factors and processes have been studied at different levels of analysis, ranging from neurobiological and psychological levels within the individual to relationships at a dyadic or group level (including families) to cultural beliefs and practices and services or policies at the community, state, or national level. Given that systems are interconnected and often embedded in other systems (such as a child whose life is embedded in a family and a classroom), as previously discussed, the resilience capacity of a person may reflect the resilience of other systems that person is connected to. Perhaps the most studied example of this interdependence of system resilience is between the resilience of a child and the resilience of the caregiving system or family caring for that child (Masten & Palmer, 2019). However, there appear to be many parallels in the commonly identified resilience qualities of individuals, families, schools, and communities that suggest vertically integrated human adaptive systems that may have co-evolved socioculturally as a result of the inherent interdependence of individuals and their social ecologies.

In fact, there are striking similarities in the resilience factors or processes identified in different literatures on resilience in children, families, schools, communities, cultures, and religions (Berkes & Ross, 2013; Crawford, Wright, & Masten, 2006; Harrist, Henry, Liu, & Morris, 2019; Masten, 2014b, 2018a, 2018b; Ungar, 2008, 2011; Walsh, 2016). Common protective factors described across levels in these different human systems include the following.

- Social connectedness
- Sense of belonging
- Optimism or a positive outlook
- Meaning
- Agency
- Self-efficacy or collective efficacy
- Problem-solving skills
- Executive function or leadership

These parallels suggest that there are meaningful processes connecting the development of these resilience factors or processes across systems. In the child literature, for example,

it is argued that effective families and effective schools have similar qualities and also that both contexts nurture resilience in children by modeling, teaching, and otherwise fostering the development of supportive relationships, problem-solving skills, self-regulation skills, agency, and a sense of belonging (Masten, 2014b, 2018b).

Models Linking Threats, Adaptive Processes, and Functional Adaptive Status

Two basic kinds of models have guided research on resilience in recent decades, sometimes described as person-focused or pathway models and variable-focused models (Masten, 2001, 2014b). Person-focused models include case studies of individuals who show positive patterns of adjustment to adversity over time and also models of life-course pathways that unfold from the interplay of many interacting influences on development. These latter models were rooted in the developmental literature in embryology, behavior genetics, and psychology on the shaping of individual development by the interplay of genes and experience (e.g., Gottesman, 1974; Gottesman & Shields, 1972; Gottlieb, 2007; Waddington, 1957/2014).

My earliest pathway models (e.g., Masten & Reed, 2002) were strongly influenced by the work of Gottesman, one of the faculty who trained the clinical students at the University of Minnesota for many years, including my years of doctoral study. Gottesman famously illustrated the various pathways of individuals with varying genetic diathesis for schizophrenia who developed or avoided this serious mental illness over the life course, depending on their life experiences (Gottesman, 1974).

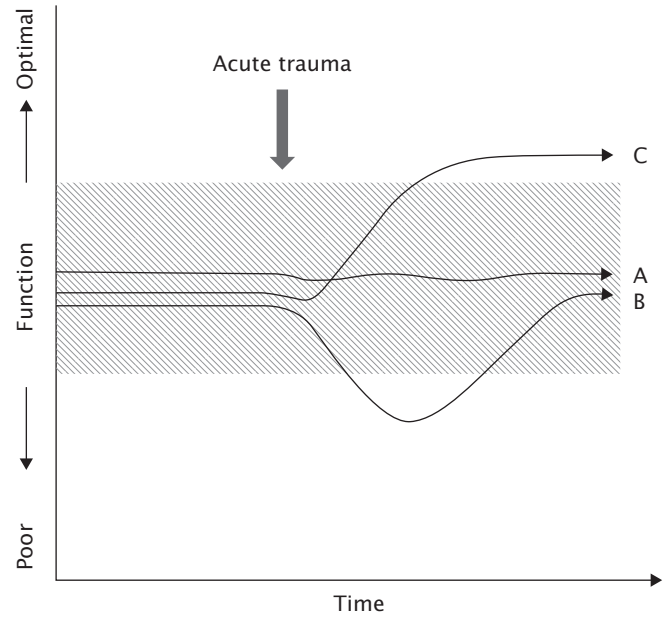

FIGURE 6.1 Resilience pathways following acute onset trauma. Pattern A = stress-resistance; B = breakdown and recovery; C = posttraumatic growth. *Source*: © Ann S. Masten. Reprinted with permission.

Early pathway models described the ups and downs of adaptive function over time in simplified form, illustrating commonly observed or hypothesized responses to acute trauma. A more recent version of responses reflecting resilience to an acute trauma experience is shown in Figure 6.1. This figure illustrates stress-resistance (a), breakdown with recovery (b), and posttraumatic growth (c). Many other patterns are possible, including breakdown patterns where resilience is not evident (at least not yet). Common examples of breakdown are a pathway of immediate breakdown without recovery of function as yet and delayed breakdown or a depletion model (see Masten & Narayan, 2012).

Figure 6.2 illustrates a model of chronic adversity, where conditions are so difficult that functioning deteriorates or remains poor until more favorable conditions occur, either naturally or through intervention. Numerous examples of recovery following chronic, severe adversity have emerged in recent decades, such as the recovery of children exposed to extreme violence or deprivation for prolonged periods, including child soldiers, children rescued from abusive homes, and children adopted from inadequate orphanages (see Masten, 2014b). While not all children recover from prolonged exposure to severe adversity, many do recover when favorable conditions are established or restored.

Recent studies have begun to document distinct pathways of adjustment following acute or chronic adversity, utilizing mixed modeling strategies of analyzing repeated measures of adjustment over time (e.g., Betancourt, McBain, Newnham, & Brennan, 2013; Meijer, Findenauer, Tierolf, Lünnemann, & Steketee, 2019; Osofsky, Osofsky, Weems, King, & Hansel, 2015). More longitudinal data are needed but these observed and measured patterns of adjustment have corroborated expected resilience patterns based on case studies

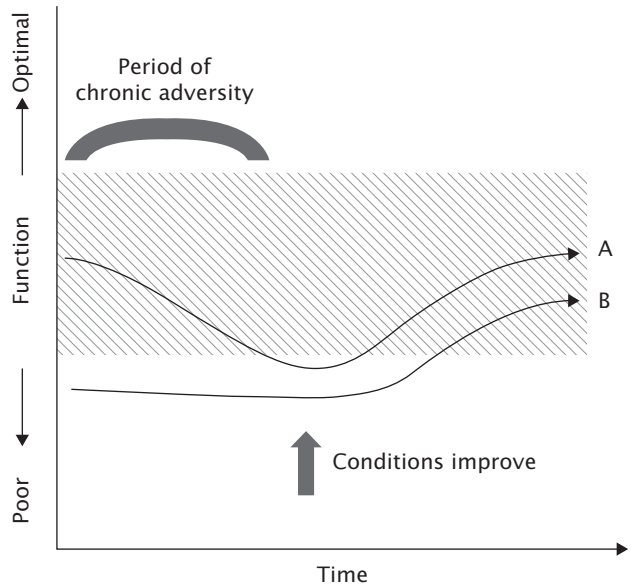

FIGURE 6.2 Resilience pathways following chronic severe adversity. Pattern A = decline with recovery after conditions improve; B = normalization when conditions improve. *Source:* © Ann S. Masten. Reprinted with permission.

or anecdotal observations to a surprising degree. Moreover, similar pathway models of resilience have been proposed and observed in the literature on adults (see Bonanno, 2004; Bonanno, Romero, & Klein, 2015).

It is interesting to note that pathway models also have been proposed in the ecology literature, and these models often take a similar form. The nomenclature varies, but patterns that resemble stress resistance, bouncing back (breakdown with recovery), or breakdown without recovery have been described in the literature on seeds, microorganisms, and soil, to mention a few (e.g., Tugel et al., 2005).

Pathway models are inherently person-focused because they usually chart how the person (or other system) is doing over time. Another kind of model central to resilience science is variable-focused, depicting major expected statistical effects, including main effects, mediating effects, and moderating effects that represent the direct, indirect, and interactional effects of multiple variables on adaptive functioning over time (Masten, 2001; Masten & Cicchetti, 2016). These models often illustrate various theories about the function of risk, vulnerability, and promotive or protective factors on the adaptive criteria of interest. Figure 6.3 illustrates major effects often tested in resilience studies, including main effects of risk factors on adjustment (negative effects), main effects of assets or other resources on adjustment (positive or promotive effects), mediated effects (usually linking intervening variables to risks and outcomes of interest), and moderating effects where one variable alters the effects of another. When a moderator produces better-than-expected outcomes in the context of risk, it is usually designated as protective or a buffer of adversity. When a moderator produces worse than typical effects, it is usually described as a vulnerability. When a moderator has varying effects depending on the nature of the environment (favorable or risky), recent models have described this as "differential susceptibility" or "sensitivity to context" (Belsky & Pluess, 2009). Main effects and moderators may be naturally occurring or the result of interventions designed to improve outcomes.

Developmental Cascades

The interactions among systems connecting the lives of individuals or families with other systems also may lead to progressive changes in any of the systems involved. Changes in children, families, or community systems resulting from systems interactions have been described as developmental cascades when they alter the course of development (Masten & Cicchetti, 2010). Such cascades reflect the fact that dynamic, interacting systems can change each other. This kind of phenomenon has been demonstrated in basic and intervention studies of children and families. Research on violence suggests spreading effects within families and also across levels in individuals, peer groups, families, and communities (Labella & Masten, 2017). Randomized controlled trials of interventions focused on parenting, for example, show effects on children at behavioral (Patterson, Forgatch, & DeGarmo, 2010) and biological levels (Dozier & Bernard, 2017; Fisher, Van Ryzin, & Gunnar, 2011). Effects of successful parenting and family interventions can spread to other family members in unexpected ways. Patterson et al. (2010), for example, observed that their parenting intervention

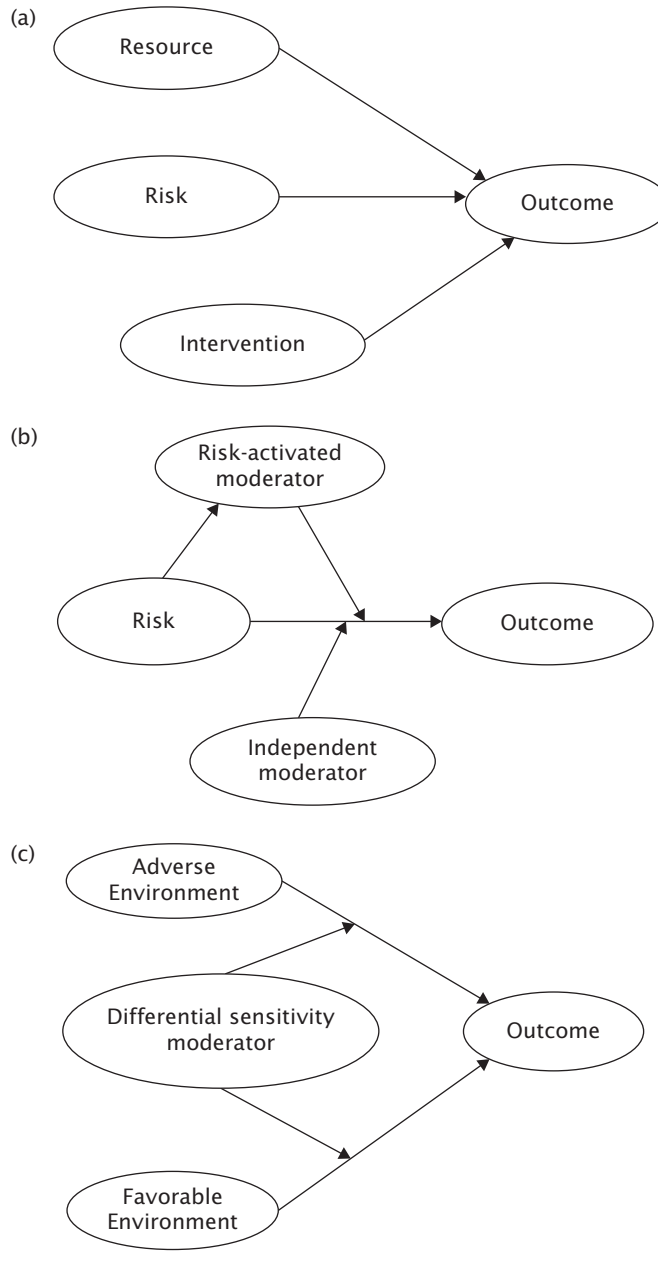

FIGURE 6.3 Common models relating risks, resources, interventions, and moderators in variable-focused models of resilience. A = main effects model. B = moderating effect of a protective factor, showing a risk-activated and an independent moderator. C = moderating effect dependent on the context; differential susceptibility or sensitivity to context. *Sources*: Figures 6.3a and 6.3b were adapted from figures by Ann S. Masten appearing in "Ordinary Magic: Resilience Processes in Development" (*American Psychologist, 56,* p. 229 and p. 231), published by the American Psychological Association. Figure 6.3c source: © Ann S. Masten. Reprinted with permission.

had unplanned positive effects on maternal standard of living indicators, such as income, occupation, and education, as well as the behavior of the target child and siblings in the family. The most effective interventions, those with spreading or sustained positive effects on the lives of children, appear to result from instigating developmental cascades.

Development itself also can have cascading consequences, for example, when maturational changes, such as the processes associated with puberty or normal brain development have consequences for behavior or social interactions. When developmental change leads to advances in the processes underlying the capacity to respond effectively to challenges, development would be bolstering resilience. Many of the fundamental human adaptive systems improve as a result of both development and experience in childhood and adolescence. The suite of skills described as executive function (EF), for example, including skills of directing attention to reach one's goals, ignoring distractions, inhibiting impulses, planning ahead, or otherwise exerting control over one's actions continues to develop during childhood into early adulthood (Zelazo, 2015).

Adversity exposure also can trigger changes that potentially result in developmental cascades, either positive or negative. The concept of posttraumatic growth (Calhoun & Tedeschi, 2006) could be viewed from a cascade perspective if the transformation has lasting effects on the life course. Stress can spur plasticity in human development with positive consequences or induce states of allostatic load that have lasting negative consequences for health (McEwen, 2016). Thus, significant challenges can be viewed as creating vulnerabilities, opportunities, or learning experiences with consequences that alter development.

Resilience Frameworks for Practice and Policy

Concepts and findings that flowed from resilience research had a transformative effect on intervention professions and other efforts to improve the lives of children and families in practice or policy (Masten, 2011, 2014a, 2014b). Pioneering scientists in resilience studies of children and families often were clinicians or educators, well aware that children and parents who needed help could not wait for science to fully understand resilience before taking any action. Thus, as research unfolded, ideas for intervention also spread, and a broad shift occurred away from deficit models toward more positive and inclusive models that focused on strengths, assets, and protective factors, in addition to risks or vulnerabilities, and positive outcomes, such as competence and health, instead of a narrow focus on symptoms or pathology.

The shift away from deficit-focused models to broader models of adjustment reflecting resilience perspectives occurred in multiple domains of practice, including psychology, psychiatry, pediatrics, nursing, school counseling, family therapy, social work, and interdisciplinary prevention (Masten, 2011, 2014b; Masten & Cicchetti, 2016). This profound shift also is evident in global humanitarian efforts to promote positive development and flourishing among children and their families contending with or fleeing conditions of extreme poverty, violence, or marginalization (Ager, 2013; Leckman, Panter-Brick, & Salah, 2014; Lundberg & Wuermli, 2012; Masten, 2014a).

Analyses and testimony by influential economists of the high returns yielded by investing in disadvantaged children, particularly early in their development, offered persuasive and complimentary evidence to policymakers on the cost-effectiveness of building a foundation of competence and health in their future citizens (Heckman, 2006, 2007; Huebner et al., 2016; Rolnick & Grunewald, 2003). Nobel laureate James Heckman has been particularly influential in papers and presentations supporting the Heckman curve (Heckman, 2006, 2019), a figure illustrating higher return on investments earlier rather than later in development. Heckman's views align with developmental theory and research indicating that "competence begets competence" (Masten, 2014b, p. 19).

A Resilience Framework for Action

In a series of publications, I have delineated a resilience framework for practice and policy based on resilience science (Masten, 2011, 2014b; Masten & Powell, 2003). This framework includes the components described in Table 6.1. These components represent my conclusions about the translational implications of resilience research after many years of interactions with practitioners and policymakers. Highlights from three decades of collaborative research on resilience among children and families experiencing homelessness illustrate the application of this model in practice and policy.

It is important to set positive goals for multiple reasons, not the least of which is the appeal to stakeholders, including children and parents themselves (Masten, 2006). The idea of preventing bad outcomes does not engender the same enthusiasm from stakeholders as promoting success. Positive objectives also ensure that positive criteria for evaluating success of a program or policy are included in models and measures. For example, in our collaborative research on risk and resilience among children and families experiencing homelessness, interest and participation rates generally have been high (Masten, Fiat, Labella, & Strack, 2015). Even during a period of uncertainty and high stress, we find parents to be highly interested in healthy brain development, school readiness, and academic achievement of their children and intrigued with research on the development of EF skills and other tools for learning that parents can support.

In a resilience framework for action, models encompass positive influences and outcomes along with risks and problems. Theories of change and logic models that guide

TABLE 6.1 A Resilience Framework for Action

Component	Approach
Mission	Set positive goals
Models	Include positive factors and processes in models of change
Measures	Measure positive factors, processes, and outcomes
Methods	Prevent or mitigate risk, boost resources or access to assets, and mobilize powerful human adaptive systems
Multiple systems	Leverage system interplay to optimize change conditions and generate cascading effects

interventions or policies include promotive or protective factors and processes and positive short- and long-term outcomes. Negative influences are not ignored, but models are broadened to encompass positive elements and change processes. In other words, resilience models for intervention transformed older diathesis-stressor models that originated in medical models of illness, broadening the focus to include assets, strengths, and adaptive processes neglected in deficit-oriented models of adjustment to adversity (Luthar & Cicchetti, 2000; Masten, 2001; Masten & Coatsworth, 1998; Wyman, Sandler, Wolchik, & Nelson, 2000). Many contemporary preventive interventions are designed now to support or protect key protective factors in the lives of children, such as high-quality parenting or caregiving. Accordingly, the logic models and theories of change for these interventions often focus on positive processes.

Our basic studies of children experiencing homelessness repeatedly have implicated EF skills and parenting quality as key promotive or protective factors associated with resilience among these children, particularly with their school success (e.g., Masten et al., 2015; Herbers, Cutuli, Supkoff, Narayan, & Masten, 2014). As a result, we have advocated for policies and practices in shelters and schools to support EF development and parenting. Furthermore, when we developed an intervention to help young children staying in shelters with their families, we targeted EF skills with an intervention that had multiple components, including parent education, family fun nights for learning and practicing EF activities, teacher training and curriculum development to enhance EF-supportive preschool activities, and individual child coaching. This program—called Ready? Set. Go!—showed promise and appeal (Casey et al., 2014; Distefano et al., 2020).

This resilience framework for action also calls for measuring positive inputs, mediators, and outcomes, along with any risk factors or negative processes and outcomes. It is particularly important for interventions targeting adaptive processes to measure those processes directly or the manifested resilience that reflects improvements in resilience. Many interventions for children have targeted parenting quality to boost resilience and improve child outcomes (Masten & Palmer, 2019). Randomized controlled trials provide strong evidence that this strategy has been successful (Sandler, Schoenfelder, Wolchik, & MacKinnon, 2011). To demonstrate change, however, it is essential to have valid measures of parenting, child adjustment, and other targeted variables.

Early resilience researchers were confronted with a paucity of positive measures of inputs and outputs, which fostered a surge of studies on measures and dimensions of child and family competence and well-being, as well as potential promotive or protective factors (Masten, 2014b; Masten & Tellegen, 2012). Resilience investigators had to validate measures developed in narrow segments of the global population for use with high-risk populations from diverse socioeconomic or cultural backgrounds. For example, in our work with highly disadvantaged, mobile families and children, it was important to examine the psychometric properties of measures of EF and parenting for this context. In regard to parenting, our studies have validated methods such as the Family Interaction Tasks developed by the team that created the Oregon model of Parent Management Training (DeGarmo, Patterson, & Forgatch, 2004) as well as the Five Minute Speech Sample (Magaña-Amato, 1993). In contrast, the NIH Toolbox measures of EF (Zelazo et al., 2013) did not work well

with disadvantaged children, which led us to create the Developmental Extensions (Dext) of these tasks (Flanker-Dext and Dimensional Change Card Sort–Dext) to improve the usability of these tasks with younger and more disadvantaged children (Kalstabakken et al., 2019; Masten et al., 2011).

Three basic methods or strategies of intervention are suggested by a resilience framework, focused on risk, resources, or resilience systems. The first is preventing or mitigating risk. Actions to reduce exposure to adversity serve to lower the burden for resilience. Many interventions take the form of harm reduction, including efforts to prevent premature birth or homelessness, a crisis nursery to provide respite to desperate parents, digging up landmines, or treating postpartum depression in new mothers.

The second basic strategy is to boost resources or access to resources that support positive adjustment or development of children regardless of risk level. Providing more assets also can take many forms, ranging from cash transfers or food to libraries and childcare. Shelters for families experiencing homelessness often provide food, clothing, childcare, transportation, healthcare, and other resources that these families typically need. Governments have the resources to provide scholarship for children to attend quality preschools and rental subsidies or housing vouchers intended to stabilize the lives of families at risk of homelessness.

A new dimension of our research on homelessness is the Homework Starts With Home Research Partnership, which is a collaboration with state agencies and community partners to evaluate efforts by the Minnesota state government to support housing stability among families with school-aged children. The program funds community programs to provide rental assistance and related supports to families as a strategy for improving education outcomes in their children. The ultimate goal of this program is improving school success in children, mediated by housing, family, and school stability.

The third basic strategy for intervention in this framework is to mobilize or restore powerful adaptive systems that protect or drive positive adaptation in the context of adversity. For children, examples include interventions that support or foster good caregiving and relationships with competent and caring adults (including teachers or mentors) or prosocial friends (peers), strengthen self-regulation or problem-solving skills, provide opportunities or routines that build self-efficacy, and other interventions that focus on bolstering known or hypothesized adaptive systems. The previously described intervention—Ready? Set. Go!—was designed to target self-regulation capacity in mobile children as a strategy for boosting school readiness.

From a multisystem perspective, interventions that support family resilience in diverse ways, through programs, therapy, or policies, would be expected to boost child resilience because their success would protect the capacity for adapting to adversity that is embedded in a child's interactions with the family. Similarly, interventions that build resilience in other systems important to children's lives, such as schools, would be expected to boost resilience of children interacting with those systems.

This resilience framework recognizes that multiple systems are involved in the capacity of any individual to adapt to challenges. The complexity of human adjustment and development provides for multiple levels of analysis and multiple leverage points for change. Knowledge about targeting and timing is in its beginning stages, and it is challenging to

identify the best targets and timing for intervening to promote positive change. Nonetheless, there is considerable interest in aligning interventions across sectors and levels to create synergy for change (Masten, 2011). Child welfare outreach and humanitarian interventions often plan for "two generation" programs or packages of intervention that coordinate health and education efforts (Christie et al., 2014; Huebner et al., 2016). Disaster relief and humanitarian interventions for war refugees typically combine multisystem efforts to provide a surge in resilience capacity at multiple levels (Masten et al., 2015), although this approach is not always described from a resilience perspective.

New Horizons in Developmental Resilience Science

Developmental resilience science continues to expand on multiple fronts, reflecting in many respects the growing edges of developmental research and technology. Notable areas of contemporary research include studies of the neurobiology of resilience, including epigenetic processes, developmental timing studies of adversity and resilience and windows of opportunity for intervening to promote resilience, cultural practices and processes that foster resilience, measures of adaptive systems at different levels of analysis (e.g., stress regulation, emotion regulation, social regulation, and community resilience), and methods to capture dynamic change. Advances in technology are making it possible and practical to study adaption in real time through wearable devices, apps for ecological momentary assessment and similar experience sampling methods, and biological parameters of stress response in the field. Progress in field-based measurement is altering the study of resilience in the context of refugee camps and disaster recovery conditions. There also is a promising alignment of researchers with humanitarian agencies and other service providers at the local, state, and international levels (Masten & Barnes, 2018).

The fourth wave of resilience science (which this volume represents) is unfolding as investigators attempt to study the interplay of multiple systems as they shape development and response to the challenges and disturbances engendered by adversity. Formerly distinct research areas are merging in the process of uncovering how systems interact in normative development and response to threats and how policymakers need to align supports and interventions horizontally across sectors and vertically across major system levels (e.g., individuals, families, communities, and governments) to nurture the next generation of citizens and weather current and future storms faced by children and families. Meanwhile, climate change is beginning to alter the ecologies that today's children will inhabit across their lifespans and the concomitant threats posed by a global population adapting to these changes (Sanson, Wachs, Koller, & Salmela-Aro, 2018).

Global threats from political conflict, natural disasters, epidemics, and the challenges of impending climate change appear to be motivating intense interest in resilience across many sectors and sciences concerned with human welfare (Masten, 2019). The scope of these challenges also underscores the importance of integrating knowledge and practice across traditional disciplinary boundaries of training and practice. Multisystem challenges

call for integrated knowledge and coordinated multisystem responses. Meeting this challenge also calls for new models of training in collaboration across sectors and disciplines (Masten, 2014a; Masten & Barnes, 2018; Masten & Motti-Stefanidi, 2020). The study of multisystem resilience is still in its infancy, but awareness of the urgency for progress is expanding rapidly.

Conclusion

Research on resilience in children and youth played a central role in the history of resilience science. Now entering its sixth decade, the study of resilience in human development has advanced and aligned with other disciplines to define and study resilience in terms of dynamic and complex adaptive systems. The fourth wave of resilience science in human development is focused on integrating knowledge and disciplines across sectors and disciplines at multiple levels of analysis to understand human capacity for adapting to challenges and to inform efforts to foster present and future resilience through practice and policy. Progress is likely to require new models of training for multisector and multidisciplinary teams to advance the science and application of multisystem approaches to resilience.

Key Messages

1. Resilience in human development depends on many adaptive systems and resources embedded in the person, their relationships, and their connections to many other systems in the environment.
2. Resilience in complex adaptive systems is dynamic because the individuals, contexts, and processes involved are always changing.
3. Resilience develops over time and childhood is an important period for nurturing resilience for the future, both for individuals and societies.
4. There are windows of vulnerability and opportunity during the life course, such as early childhood, early adolescence, and the transition to adulthood, when a confluence of changes in children and their contexts creates high plasticity and potential for transformation.
5. Progress in the science and applications of resilience in human development requires the integration of knowledge from multiple disciplines and sectors across multiple levels of analysis, along with training in multisystem collaboration.

Acknowledgments

The author is grateful to all the mentors, colleagues, students, research participants, and funders who have contributed to the ideas and findings discussed in this chapter. Preparation of this chapter was supported by the Irving B. Harris and Regents Professorships in Child Development.

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