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Resilience

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Synthesis

How important is it?

When children show healthy development in spite of adversity, it is called resilience. Young children can experience many forms of adversity – sometimes mild, like not being understood by adults when trying to express their needs; sometimes severe, like being exposed to poverty, domestic violence and war. Faced with heightened adversity, some children will develop negative outcomes whereas other children will stay on a healthy course or “bounce back” and resume typical development. What would be called “competence” in children growing up in a low-risk environment becomes “resilience” in children facing adversity. Whether or not children are resilient depends on the resources available to them in their families and communities, and their own emerging personal resources. All young children need to grow up in a safe and nurturing environment and to establish stable relationships with their caregivers. In times of adversity, they need these resources even more. Resilience should thus be seen as a developmental process, drawing on strengths in families, communities and individual children. Young children cannot achieve healthy development on their own when their social support network is in disarray. The main goal of resilience research is therefore to identify the features of children’s lives that can be nurtured or changed to help them develop competence and resilience when adversity occurs. Another key question is how the individual characteristics of young children interact with their environment to promote or jeopardize resilience.

What do we know?

Ongoing studies of resilience in early childhood help us define what can be considered healthy development in context of adversity, what the effects of trauma are at a young age and what factors are associated with resilience. In resilience studies, healthy development is often defined in terms of accomplishing developmental tasks, some of which are universal, such as forming close bonds with caregivers or learning to talk, and some of which are culturally or historically specific, such as learning to weave or hunt bison. Another way of defining good development in adversity is by the absence of symptoms or problems linked to trauma, such as signs of posttraumatic stress disorder (PTSD). Manifestations of PTSD in young children are not very well documented and can differ from those of adults and older children. Children younger than age 3 who suffer from PTSD may have difficulty explaining their feelings. They may also become irritable and/or reenact the traumatic event through play.

Exposure to trauma and neglect in early childhood can affect brain development and thus have long-term consequences. The elements that foster good development in adversity and in milder circumstances are similar. Children need to be fed, protected and stimulated; just as importantly, they need to establish the early interpersonal relationships that are the foundations for cognitive, affective and neurobiological adaptation. Through relationships, young children learn to regulate their emotions, an important skill to deal with adversity, and to develop self-esteem, self-efficacy and coping abilities. As children grow, different relationships play different roles in providing resources and protection.

Still, even in similar circumstances, not all children will develop or bounce back equally well from adversity. This is partly due to their differences in regulation and executive functioning skills (the goal-directed cognitive abilities to control thought, behaviour and emotions). Children with better executive function skills are also better able to navigate in a changing environment. Children may inherit genetic variants that make them more susceptible to environmental influences; they will thrive in a positive environment but will suffer more from the consequences of adversity. Resilience is a complex phenomenon shaped by family and community resources interacting with individual characteristics. Supporting resilience in the early years implies empowering families and communities but also taking into account the differences between children that will make interventions more or less successful.

What can be done?

Children who show resilience do not have rare or special qualities; they have better protections and more resources in themselves, their families and their communities. Therefore, the first step to foster resilience in young children is to ensure that they have these protections and resources, including the material resources and stimulation they need, and a context favorable to establishing stable and positive relationships with their caregivers and later with other members of their communities. Encouraging resilience in young children primarily means supporting their families. Children considered resilient generally have parents with fewer psychological symptoms and a stronger social network.

Psychological treatment of young children exposed to traumatic events is usually based in attachment therapy and involves a parent. If they can do so supportively, caregivers could discuss the trauma with children in age-appropriate ways to help them put the event in perspective, regain confidence and move on. It is also important to re-establish a daily routine in a safe environment, even if pre-trauma conditions cannot be fully restored. Interventions targeting the environment to promote resilience in young children should aim at maintaining or reestablishing a context favorable to practicing normal activity and establishing normal relationships.

Another way of fostering resilience in young children could be to help them develop the abilities they can use to cope with adversity and take advantage of available resources. Self-regulation could be one of these skills. Individuals differ in their physiological reactivity to stress and their ability to regulate it, both developing in response to environmental input. More research is needed to examine the complex relationships between physiological reactivity, self-regulation skills and resilience. Executive function skills, like retaining information in working memory, sustaining or shifting attention, and inhibiting automatic responses to perform a goal-directed action, could also play a protective role in high-risk environment. However, exposure to adversity may harm executive function skills. Therefore, since executive function skills seem malleable to intervention, helping children exposed to adversity develop and maintain these skills could be a good way to promote resilience. Although promising, intervention programs targeting children’s skills to promote resilience have yet to show that they can be effective in the long term. Moreover, such programs should take into account children’s differences in their susceptibility to respond negatively to adversity and to respond positively to intervention. Finally, more research aimed directly at documenting the expression of trauma and resilience in children younger than age 5 is necessary to understand their particular needs and develop appropriate intervention programs.

Early Resilience and Multidimensional Health Outcomes: Positive Childhood Experiences (PCEs) in the Context of Childhood Adversity

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Introduction

Developing children encounter adversity and have opportunities for resilient functioning at many ages and stages. Developmental pathways of risk and resilience begin to take form during conception and the prenatal period, and the roots of these pathways also stem from the adaptation and maladaptation of previous generations.[1,2] In the case of child development, we define resilience as the dynamic capacity to successfully develop, thrive, and maintain positive functioning despite the presence of risks to healthy adaptation.[3,4] In other words, resilient functioning cannot be observed in the absence of risk or adversity that threatens children's positive development.

Subject

Knowledge of how to identify and promote resilience processes across development is key to understanding points at which child functioning may continue on a positive trajectory or diverge towards maladaptation.[5] Early childhood, defined as birth to age five, is a foundational period when positive development – and the capacity for long-term resilient functioning – begin to consolidate and form the building blocks of subsequent development.[2] For instance, secure attachment bonds, strong emotion regulation skills, mastery motivation, and the emergence of self-esteem all begin to develop during early childhood and set the stage for healthy relationships, socioemotional competence, educational and vocational achievement, and life satisfaction across the lifespan.[5,6] The presence of safe and predictable relationships, coping skills, and self-confidence in the early years also protect against the effects of childhood adversity, such as abuse, neglect, exposure to violence in the family and community, and poverty on long-term health problems and premature mortality.[7]

Problems and Gaps in the Literature

To date, research has more heavily focused on the negative side of this story – that early adversity predicts long-term health problems – rather than the positive side of the story – that early resilience factors can counteract the effects of adversity and promote better lifespan health and wellbeing. Indeed, the last 25 years of research in psychology, medicine, and public health have yielded a wealth of studies on the effects of childhood adversity on health problems,[8] but much less on the role of positive childhood experiences (PCEs) on better health outcomes. However, the vast majority of individuals who experience childhood adversity do not have negative health outcomes, which points to the commonly-occurring phenomenon that resilience processes are often at play, although they remain under-studied.[4]

Research Context

In the last five years, increasing research on PCEs has shown that adults who report having had safe and supportive childhood relationships (e.g., with caregivers, teachers, friends, and mentors), predictable structure and home routines, connections to the community, and a positive self-image have fewer current health problems and health-risk behaviors, and less exposure to stress, even after accounting for the effects of childhood adversity and contemporaneous supportive resources on health problems.[9,10] This pattern illustrates the particularly robust association between PCEs in the early years on adulthood functioning. Furthermore, recent studies confirm that the vast majority of individuals have PCEs as well as some degree of childhood adversity; PCEs and childhood adversity naturally coexist, and PCEs often work behind the scenes to counteract the effects of childhood adversity on negative life outcomes.[10,11,12,13]

Globally, researchers have also taken interest in assessing PCEs in developing as well as developed countries and with individuals and families of diverse identities and backgrounds. Several studies have found that PCEs, especially when operationalized and assessed with cultural sensitivity and responsiveness, are common in many populations and directly predict better health outcomes, at times even more robustly than the effects of childhood adversity on negative health outcomes.[11,14,15]

Key Research Questions and Recent Research Results

Emerging PCEs research has examined the mechanistic processes by which PCEs relate to better outcomes despite childhood adversity. A recent systematic review reported that for many individuals around the world, higher levels of PCEs directly relate to better mental health (e.g., fewer depression, anxiety, and post-traumatic stress disorder, PTSD symptoms) and less psychosocial stress.[11] Although few in number, some studies have shown that PCEs directly interact with and buffer against the effects of childhood adversity. However, this line of inquiry remains underdeveloped.[13] Studies have also begun to examine whether the developmental timing of PCEs specifically in early childhood (birth to age 5) rather than later in childhood and adolescence, uniquely predicts better outcomes, with some studies supporting that early childhood PCEs relate to lower stressful life events later in life.[16]

Strategies to Address Research Gaps

Until recently, research on childhood adversity has primarily employed a deficit-based model, focusing on negative implications of childhood adversity on poorer health outcomes. However, research that underscores the critical importance of PCEs on positive outcomes also highlights opportunities for resilience. This resilience-based lens instills hope and empowers individuals, particularly those who are minoritized and marginalized and experience systemic and structural racism and oppression.[4]

A unique advantage of focusing on and assessing PCEs is that it can be done with brief yet effective instruments, such as the Benevolent Childhood Experiences (BCEs).[10,13] These scales include 20 items reflecting favorable experiences, resources, and relationships from childhood, with 10 items being common in many diverse populations and 10 items beings slightly less common but nonetheless critical in the face of adversity.[13] Moreover, assessing for PCEs even in the absence of assessing for childhood adversity provides unique and important information. For instance, while screening for childhood adversity informs understanding of individuals' childhood exposure to adverse events, it does not provide understanding of the presence or extent of early protective resources. In other words, even if individuals do not report having experienced childhood adversity, this only confirms that negative life events did not happen (but it does not give information on what did happen that was good). However, screening for PCEs informs understanding of childhood resources that were present and could be leveraged for long-term resilience, and it also informs understanding about which resources were not present but should have been. Put differently, the presence of PCEs signals potential for resilience, and the absence

of PCEs signals an under-resourced childhood, both of which are highly informative for screening, assessment, referral, and intervention strategies.[4,12]

Conclusions

Research on PCEs is exponentially increasing each year, with the potential for exciting future endeavours to also link adults' PCEs to their lifespan physical health and relationship quality (e.g., as romantic partners and also as parents), and the intergenerational transmission of resilience to PCEs in offspring. One of the most powerful aspects of PCEs is that many adults have had them, yet they do not even know it. When adults or parents face overwhelming stressors due to oppression, marginalization, and poverty, they often do not have the time to reflect on their positive experiences from childhood, which themselves could be used as existing templates to recreate positive experiences with their children.[2] When PCEs are introduced into the conversation to assess traumatized adults' and parents' childhood resources, the vast majority of these individuals react favourably and convey an appreciation for the opportunity to reflect on positive experiences. For example, most parents who are overwhelmed with securing unmet basic needs for themselves and their family and coping with ongoing stressors do not regularly take the opportunity to reflect on PCEs as potential resources they possess that could be harnessed into templates to recreate PCEs with their children.[17]

Implications for Parents, Services, and Policy

In practice, assessing PCEs provides individuals the chance to reflect on their childhood assets, resources, and strengths. Providers should not only assess adversity, but also assess PCEs using scales such the BCEs scales. The BCEs scales take under five minutes to administer and reflect many common and favorable childhood experiences that are mostly independent of socioeconomic status.[13] Experiences of adversity are often inevitable for most people, but the presence of PCEs, such as safe and caring adults, predictability and support in the home, school and community; and opportunities to develop a positive self-concept may prove to be stronger predictors than childhood adversity of long-term outcomes.[10,18]

A disproportionate amount of ACEs impact youth from marginalized communities given that poverty, oppression, and childhood trauma co-occur.[19,20] However; social policies that help adults and parents recover from traumatic stress linked to their own childhood adversity and promote opportunities and access to high-quality services for all diverse families will ultimately strengthen

the presence of PCEs and promote positive development for all youth despite adversity. Focusing on childhood resources may be a separate, but equally important concept to assess in addition to (or in place of) childhood adversity. Ultimately, reducing barriers to health services and health disparities and strengthening less commonly-reported PCEs (e.g., access to nutritious food, adequate public safety, and perceived acceptance and belongingness in one's family and community) will promote positive adjustment and resilience for all people.

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Resilience in Development: The Importance of Early Childhood

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Introduction

The concept of resilience, originally from the Latin resilire (to rebound, recoil, or spring back), is now widely utilized in multiple fields of study to refer to the capacity of a system to respond effectively to challenges that threaten its function, survival, or development.[1-3] It is applied in psychology, ecology, engineering, communications, and disaster management, among other fields.[3,4] In developmental child psychology, resilience refers to resources and processes that promote and protect positive adaptation or development in the context of risk or adversity.

Although people have been fascinated with stories of resilience for thousands of years—judging from ancient tales of individuals who triumph over adversity—the scientific study of resilience in children began around 1970.[1-3,5] Nonetheless, great strides have been made in the past five decades of research and it is clear that early childhood is an important window of time for understanding and fostering resilience.[6-9] During these years, the roots of competence are established and many of the most important protective systems for human development emerge. Thus, early childhood holds great promise for interventions that prevent and reduce risk, boost resources, promote competence and build a strong foundation for future development.

Subject

Understanding naturally occurring resilience provides important clues for policies and practices designed to promote healthier development in children threatened by adversity or disadvantage. It is also vital to learn how to foster positive change, so that the odds for favourable development can be improved. Prevention and intervention studies are essential to test the ideas coming from resilience research, to learn the best targets, methods and developmental timing for interventions, and also to learn which approaches work best for whom.[1-3,10-13]

Problems

To study resilience, one must define and operationalize it.[14] This has proven to be challenging for several key reasons. First, resilience refers to a variety of phenomena, such as recovery after the loss of a parent, emergence of normal developmental milestones after a child is adopted from an institution, school success among children growing up in poverty or dangerous neighbourhoods, and mental health in children who experience maltreatment.

Second, resilience is inferred from judgments about what constitutes desirable or "good" outcomes as well as criteria for measuring adversity or risk, which can vary among cultures and investigators.[2,3,5,14-16] Investigators must define the criteria for positive adaptation, and also the standards and measures of adversity or risk confronting the child. A child who develops well may be viewed as adaptive or competent, but not necessarily as manifesting resilience, unless some explicit or implicit threshold of risk or adversity has been met. It is also clear that there are multiple criteria by which to judge positive development or success in life; adaptation is inherently multidimensional and multifaceted. Thus, it is not surprising that definitions and measures have varied, making it complicated to build a coherent body of knowledge about resilience in development.

Third, many processes at multiple levels of analysis are likely to be involved in human resilience.[1-4,17,18] To understand resilience, one must understand the complex behavior and development of living systems in context over time, from "neurons to neighbourhoods"[19] and beyond. Nonetheless, findings from the first generation of resilience research were remarkably consistent, suggesting the influence of powerful but common adaptive processes.[1,3,15]

Research Context

Systematic research on resilience in childhood emerged from studies of vulnerability and risk in the search for the causes of mental illness.[1-4,20] Investigators began to study children with elevated risk for problems, often due to mental illness or stress in the family, social disadvantages, or poverty. The goals of pioneering researchers, including Norman Garmezy, Lois Murphy, Michael Rutter, Arnold Sameroff, and Emmy Werner, required integrative perspectives and collaboration among developmental and clinical scientists. Such collaborations forged a new science of resilience in development, while at the same time energizing the rise of developmental psychopathology.[1,15,21] The great insight of these pioneers was recognizing the potential of resilience research to inform practice and policies aimed at better development among high-risk children.

Key Research Questions

Developmental studies of resilience often address the following questions:

- What accounts for positive development or recovery among children who experience hazardous circumstances?
- What are the most important resilience factors and processes that promote and protect human development in the context of risk or adversity?
- What are effective strategies for building resilience and fostering positive development among children whose development is threatened by adverse childhood experiences?

Although resilience researchers focus on positive outcomes and their causes, they also acknowledge the importance of understanding risks and threats to development and how to prevent, reduce, or eliminate them.

Recent Research Results

There is exciting convergence in developmental research on competence, resilience, behavioural and emotional problems, brain development and prevention science, all underscoring the importance of early childhood for building protections into human development at multiple levels, within the child, the family, the community and their interactions.[6-13,22-24] During these foundational years, it is crucial for children to have sensitive caregiving and stimulation, as well as the clean water and air, nutrition, healthcare, and other material needs required for healthy development. Early foundations of resilience emerge through caregiver-child attachment bonds, interactions with family and other people, healthy brain development, opportunities to play and explore the world around them, and many other interactions with the environment. Many learning and self-control skills develop by the preschool years, and many of these early cognitive and social-emotional skills are related to the quality of available caregiving.[25-28]

Effective preventive intervention programs during infancy and preschool years support caregiving in multiple ways and provide enriched learning environments for children.[7,9,29] Such programs nurture resilience in child development. Early success in school – related to effective care, positive home-school connections and effective classroom practices – appears to be a key segue to resilience in childhood, particularly for very disadvantaged children.[2] Programs or systems of care that focus on building competence and strengths in young children and their families, along with

reducing risk and addressing problems early, are yielding promising successes.[2,8,9,11,12,30,31]

A neurobiology of resilience is also beginning to emerge.[17,18,20,29,32-34] New insights into brain development and plasticity, how stress interacts with development, and the interplay of genes and experience in shaping development promise to revolutionize the science of resilience and prevention in early childhood.

There is growing recognition that multisystem threats to human development posed by complex adversities, such as extreme poverty, natural disaster, pandemics, armed conflict, and systemic racism or historical trauma, require multisystem thinking together with coordinated preparation and responses.[35-38] As a result there is more attention to preventing and mitigating harmful adverse experiences in early childhood while also harmonizing investments in resources, and mobilizing multiple sectors and systems to promote healthy development, particularly among children at risk due to poverty, trauma, and other adverse circumstances.

Conclusion

Resilience research indicates that during the early childhood years, it is important for children to have good quality care and opportunities for learning, adequate nutrition, and community support for families, to facilitate positive development of cognitive, social and self-regulation skills. Young children with healthy attachment relationships and good internal adaptive resources are very likely to get off to a good start in life, well equipped with the human and social capital for success as they enter school and society. Such children typically manifest resilience in the face of adversity, as long as their fundamental protective skills and relationships continue to operate and develop. The greatest threats to young children occur when key protective systems for human development are harmed or disrupted. In early childhood, it is particularly important that children have the protections afforded by attachment bonds with competent and loving caregivers, the stimulation and nutrition required for healthy brain development, opportunities to learn and experience the pleasure of mastering new skills, and the limit-setting or structure needed to develop self-control.

Implications

Resilience research, studies of normal development and psychopathology, as well as prevention science all highlight the importance of early childhood for establishing fundamental protections afforded children by positive relationships, healthy brain development, good self-regulation skills,

community supports for families, and learning opportunities. A resilience framework for practice and systems of care has emerged, with an emphasis on building strengths and competence in children, their families, their relationships, and the communities where they live.[2,35-38] It is clear that many children in modern societies face multiple and accumulating risks that require multiple protective interventions and comprehensive efforts to prevent or ameliorate risks to children and their families.[2,7,23,36-39] No child is invulnerable and, as risk levels rise, fewer children escape the developmental consequences of adversity. Early childhood is a crucial window of opportunity for families and societies to ensure that children have the resources and protections required to develop the adaptive tools and relationships they will need to engage the future well prepared.

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Early Childhood Relationships and the Roots of Resilience

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Introduction

As the expression of competence in contexts of adversity, resilience is of great interest to researchers and practitioners in its own right, as well as for what it can tell us about development in contexts of security. Indeed, processes that engender positive adaptation despite adversity are more similar to those that influence typical development than they are different.[1] Nowhere is this more apparent than in the role of relationships as central risks and resources for understanding resilient adaptation.

Whether in contexts of adversity or security, early relationships form the foundation for cognitive, affective and neurobiological adaptation.[2,3] Whereas relational vulnerabilities engender distress and maladaptation, relational resources foster emotional health and competence.[4,5] In the context of safe and responsive relationships with caregivers and others, young children develop core regulatory and relational capacities that enable them to maximize developmental opportunities and effectively negotiate developmental challenges. When early caregiving environments are sub-optimal, alternate relationships within and beyond the family can serve as powerful conduits for children's (re)organization thereby opening pathways to resilience.

Subject

Efforts to identify the relational roots of resilience can illuminate modifiable developmental influences that can be harnessed in the service of positive youth development. Prevention and intervention efforts can aim to protect, restore or provide positive relationships in contexts of risk. When taken to scale through family preservation services, community-based mentors, foster or adoptive parent education, and other systematic support services,[6,7] relational resources can engender children's capacity to reach age-expected and culturally significant milestones. Thus, as prominent gateways to both positive and problematic adjustment, relationships are a key focus of resilience research.

Key Questions and Recent Research Results

Which relationships are important for understanding resilience in early childhood?

Relational resources vary in both form and function across development. Parents, age-mates (e.g., siblings, peers, partners), and nonparental adults (e.g., teachers, mentors) vary in their relative influence across developmental periods and contexts. While platonic peer relationships are salient during the school and early adolescent years, for example, romantic relationships become increasingly influential in later adolescence and adulthood. Despite these variations, the roots of relationships and, to a significant degree, of resilience are grounded in the foundational experiences of early childhood.

In the context of the early caregiving relationship, children develop core regulatory and relational capacities. In addition to the basic substrates of stress reactivity and regulation, patterns of exchange in the early caregiving relationship inform children's emerging expectations of self and others.[4] Over time, relationships with siblings, peers, and other adults may further canalize or challenge these early relational schemas. Indeed, accumulating research evidence demonstrates the enduring capacity for nurturing relationships to provide opportunities for change. Thus, children's successful adaptation in contexts of adversity (i.e., resilience) reflects the combined influence of early and ongoing experiences in multiple relationships. Over time, early adaptive patterns may be magnified or re-directed through connections with relational partners outside the family, particularly in school, with peers, and in the community.

Although we typically think of the early caregiving relationship as originating in the recurrent exchanges that typify the caregiver-infant relationship, recent research directs our attention even earlier, to pre- and perinatal periods of development. For example, as assessed during pregnancy, mothers' relational representations of their own childhood experiences predict the quality of the mother-infant relationship one year later.[8] Beyond mothers' own childhood experiences, studies of prenatal attachment[9,10] demonstrate that mothers' attachment to their unborn child during pregnancy predicts the quality of the mother-infant relationship postpartum.

While attachment-related representations of self and baby are central in the unfolding process of maternal and child development, these influences are not determinative. Even early after birth, shifting environments can promote resilience. For example, prenatal stress is linked to deleterious brain morphology, such as smaller hippocampal volume, yet postnatal maternal sensitivity,

maternal receipt of social support, and good socioeconomic conditions can buffer these links.[5] Likewise, a review of interventions to address maternal postpartum mental health problems found that diverse forms of psychoeducation and mother-infant interaction supports, such as infant massage, group and individual psychotherapies, and video feedback sessions, can promote improved mental health, bonding, and relationship outcomes for these dyads.[11] Hence, the relational roots of resilience reach from prior generations through attachment representations to support and frame children's negotiation of contemporaneous and prospective developmental issues and challenges. Moreover, even when the prenatal environment confers vulnerability, perinatal interventions, particularly those focused on promoting parent-infant relational security, can provide a foundation for future resilience.

How do relationships contribute to resilience?

Resilience research has identified several mechanisms by which protective and vulnerability factors operate to increase or decrease the probability of competence in contexts of adversity, respectively.[12] First, as noted previously, sensitive caregiving engenders adaptive neurobiological, behavioural, and cognitive organization in early childhood.[4,8] Thus, positive relationships contribute to resilient adaptation by promoting resources, such as self-esteem, self-efficacy, and coping capacities. Second, relationships can mitigate risk impact, such as when a sibling provides sensitive supervision to a younger sibling at a time when the parent is unable to do so. Third, relational processes may stymie the progression of negative chain reactions, such as when the presence of an alternate caregiver may quell the series of negative consequences that might otherwise befall a child in the wake of parental loss.[13] Finally, relationships may introduce new opportunities for positive adaptation,[14,15] such as when a mentor exposes a young child to positive outlets for expression and connection through new interests, art, or sport.

Just as the salience of specific relational partners (e.g., parents versus peers) varies over time, the content and meaning of relational qualities may vary by context. Resilience research highlights the need for a contextually- and culturally-sensitive view of development. Sensitive and responsive caregiving engenders positive youth development, but the specific features that constitute high quality care may look different across cultures.[16] In contexts of heightened risk, relational factors that are associated with poor outcomes in low-risk contexts may engender positive development. For example, studies have shown that some dimensions of authoritarian parenting (i.e., high parental control, low warmth), which may be detrimental for some youth,[17,18] can be less deleterious and perhaps promotive for children in risky environments or within some

cultural groups.[19,20,21] Similarly, although parentification (i.e., caregivers charging children with parental caretaking) was once considered inherently detrimental to development,[22] children's provision of care to parents and kin may confer heightened self-esteem and achievement in some groups. Together, these studies show that the developmental effects of specific relational dynamics can be influenced by the culture and value judgments of individuals within the family.[23,24]

Implications for the Policy and Practice

The quality of early caregiving relationships has an enduring, though not definitive, impact on a child's development. Thus, efforts to support these relationships are central to most prevention and intervention programs in early childhood (e.g., home visitation programs,[6,7] child-parent psychotherapy[25]). Even in contexts of extreme adversity, such as out-of-home placement, supporting a positive caregiver-child relationship is vital to successful intervention in infancy and early childhood.[13,26] To that end, several factors are central to support the relational roots of resilience.

First, prevention and intervention efforts must start early, even before birth. Working with expectant parents, biological or otherwise, is essential to support positive development, particularly for children at heightened risk due to parents' own legacies of loss and trauma and/or contemporaneous stressors, such as poverty or war.[27] In early development, support services may expand beyond the caregiving relationship to consider siblings, peers, and teachers as resources who can protect and provide positive relational processes.[28,29]

Second, relational supports must extend beyond the childhood years to ensure positive youth development. Early relationships are special, but not determinative. Just as opportunities for righting maladapted trajectories remain in later development, so, too, might early positive trajectories be derailed by subsequent adversity. Positive relationships should be supported and protected across the life course, particularly as they become contexts in which the relational roots of resilience for future generations may flourish or flounder.

Finally, applied policy and practice must be sensitive to individuals' developmental and cultural contexts. Individuals may value and interpret experiences, including presumed adversities, very differently as a function of their developmental and/or cultural context. Thus, researchers and practitioners alike should attend to individuals' unique solutions to the challenges of adaptation and remain open to the possibility that specific relational features may have multiple dimensions

of meaning across settings. Indeed, even a presumably negative or deviant relationship (e.g., criminal association through gang activity) may confer some relational protection to vulnerable youth by providing a sense of security and connection. Only by studying individuals in context can we begin to understand the complexity of resilience as a developmental construction over time and in the context of lived experience.

Conclusions

Resilience is a relational process that reflects organizational qualities among systems and among people. It is not a personality trait or genetic endowment, it is not something one has or lacks; it is a capacity that is differentially expressed depending on the relational resources at hand. Resilience in early childhood and beyond reflects dynamic *processes* of adaptation that can be engendered or compromised by close relationships to a significant degree. Applied efforts that are appropriately sensitive to developmental, cultural, and contextual factors have tremendous potential to mobilize the power of relationships in support of positive development for all children.

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The Role of Physiological Response in Understanding Resilience Processes in Children's Development

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Introduction

Stress and adversity affect children in different ways. Some children develop behavioral or emotional challenges when exposed to difficult environments, while others overcome challenges and thrive. For decades, researchers have studied this variability in children's developmental outcomes to try to identify individual, family, school, and community processes that help some children to show "resilience" — that is, positive adaptation in the face of adversity.[1] By investigating physiological sensitivity and responses to adversity, researchers can gain more holistic understanding of how the interplay of biological and behavioral adaptations support or undermine children's resilience processes across different contexts.[2-4] Despite focusing on individual differences in adaptations and experiences, developmental psychologists recognize that children's capacity to respond to adversity depends largely on their access to contextual resources and supports as well as systemic processes and social policies.[5-7]

Research Context

When children are exposed to various types of challenges and stressors — ranging from everyday difficulties to pervasive and chronic adversity— their bodies respond. Physiological responses are a set of highly integrated changes including those related to heart rate, breathing, and stress hormones. By studying differences in children's physiological response, researchers are revealing the dynamic interplay between contextual adversity, biology, and behavioural adaptation. Individual differences in children's physiological responses are complex and dynamic because they can be shaped by early experience, can change over time, and differ depending on the type of challenge. Physiological response can be measured as a relatively brief reaction to an acute stressor (i.e., "reactivity"), or more prolonged response that reflects cumulative responses or adjustments over time. Further, the effect of children's physiological responses on their emotional

and behavioral adaptation can vary across different contexts.

Current research has focused on two systems of the body that are activated when children face challenging or stressful situations. The first system is fast-acting, known as the “fight or flight response”, and can also help the body recover from a state of arousal and regulate it back to homeostasis. The second system is slow-acting and prepares the body for chronic exposure to stress by suppressing systems that do not promote immediate coping and increasing available energy to manage stress.[8] These systems’ responses can be measured using various non-invasive measures such as cardiac readings (e.g., electrocardiogram) or hormone levels (e.g., cortisol) collected from saliva[9] or hair samples.[10]

Key Research Questions

Researchers studying how physiological response is associated with resilience are tackling these key questions:

1. How do children’s early adverse experiences relate to their physiological response, and can supportive interventions help?
2. How do children’s physiological response and the environment interact dynamically to explain differences in adaptation and resilience?
3. What skills and experiences can help children regulate their physiological arousal and promote positive adaptation?

Recent Research Results and Gaps

Physiological response as an index of adversity exposure and intervention effectiveness

Children’s experiences of adversity may play a role in shaping their physiological stress responses over time.[11] Studies have shown that children’s exposure to adversity is associated with dysregulated physiological stress response that is either too high or too low.[12,13] For example, children who grow up with parents who are less sensitive or are abusive often display heightened physiological reactivity to acute stressors.[12,13] Early experiences of fear may sensitize children’s systems to react more readily to future threatening situations by heightening their stress response.[14–17] This heightened physiological reactivity may be protective in situations of immediate threat, but over time, is associated with increased susceptibility to psychopathology such as depression or anxiety.[18,19] This association provides evidence of the “biological embedding of

adversity" a hypothesis which states that early exposure to negative environments affects the children's central nervous system, and over time may adversely impact their cognitive, social, and behavioural development.[20]

To capture the wear-and-tear of various physiological stress response systems in the context of chronic adversity, researchers have employed a cumulative index of allostatic load.[21] Allostatic load is a way of measuring multiple types of heightened physiological stress response and inflammation (e.g., including heart rate, blood pressure and cortisol levels and immune and metabolic markers) that are linked to poor health outcomes in adulthood.[22,23] Children who experience greater adversity early in life consistently show greater allostatic load which in turn is linked to a broad range of negative outcomes later in life.[24,25] Even youth who are raised in poverty but appear to be well-adapted in their emotions and social behavior show high levels of allostatic load.[26] This finding suggests that resilience can be "skin deep"; physiological markers can reveal the toll adversity takes on the body even when children appear to be thriving.[26] Other ways of measuring wear-and-tear on the body include oxidative stress and metabolic markers, which are also elevated among children who face high levels of adversity.[27–29]

The processes through which adversity "gets under the skin" depend on the intensity, timing, and length of stress and adversity exposure.[20] Thinking about the timing and type of measurement is crucial. Recently, researchers proposed two distinct pathways to further elucidate how adversity can become biologically embedded.[16] This "dimensional model" distinguishes between children's experiences of active threat in their environment versus deprivation or lack of access to crucial resources or supports.[16] Other researchers point out that many stressful childhood environments involve both threat and deprivation; these two dimensions are often inextricable and shape stress response systems together.[25] Further, they highlight that measurement should capture children's subjective perceptions of adversity, as not all children may experience a given stressor the same way.[25] Future research that attends to these measurement issues can advance knowledge of children's physiological response and adaptation to adversity.

Physiological markers may also be useful for indicating treatment effectiveness in ways that have relevance for child policy and practice. For example, infants of women who received a mindfulness-based intervention during pregnancy showed more self-regulated behavior and more efficient physiological response and recovery from a stressor.[30] In another study, foster care children who received a therapeutic intervention did not show expected dysregulated cortisol rhythms when they changed placements, compared to their foster peers who did not receive the

interventions.[31] These studies suggest that early supportive intervention may reduce physiological risks associated with residential and caregiving instability.[32,33] At the same time, a recent systematic review found that the results of different studies were mixed and depended on the specific physiological stress response system.[33] This finding highlights a need to better understand how to design and target interventions to mitigate the negative impacts of adversity on child physiology and wellbeing. In addition, more research could explore whether children's physiological stress responses explain why certain interventions work for some children but not for others and elucidate how to better design and target services.

Physiological response as a marker of susceptibility to environmental influences

Indices of physiological reactivity to stressful experiences has been conceptualized as a marker of susceptibility to contextual influences. Applying evolutionary principles, researchers theorize that children who show heightened physiological or behavioural reactivity are more sensitive to both positive and negative environments than their peers who exhibit lower reactivity, that is, "for better and for worse".[34,35] High physiological reactivity may be maladaptive in contexts of adversity, but healthy and promotive in contexts of nurturance and protection. For example, children with high levels of physiological reactivity displayed more behavioral challenges when raised in families with high levels of adversity (e.g., conflict, stress, low income), but more positive behavioral adaptation in families with relatively low adversity.[36,37] Framed another way, children with low reactivity showed better adjustment in contexts of adversity.

While many studies have demonstrated the association between low reactivity and better adjustment in contexts of adversity,[36,37] in some cases, low reactivity could be protective. For example, there is evidence that high physiological response may be protective for children who are exposed to interpersonal conflict.[38] In addition, relatively higher levels of physiological response over time may be protective in circumstances of extreme poverty where stress response systems can become blunted.[39] The adaptive calibration model[2] distinguishes between two profiles of maladjustment in contexts of high adversity: low stress responsivity that is related to callous-unemotional traits (e.g., lack of empathy), and higher stress responsivity that is associated with more anxious patterns of emotion and behavior. This work highlights the plasticity of children's physiological response and the importance of disentangling in which specific conditions high or low response has a buffering effect against adversity.[11]

Given that most research on children's stress physiology has come from the United States context, more research is needed in low- and middle-income countries to provide greater

representation of children's experiences worldwide. Further, research from low- and middle-income countries can help us to understand how children's stress physiology interacts with other biological processes including access to nutrition, and pathways of infection and inflammation that may activate or interplay with stress response systems. This research will be strengthened if we also include measures of positive environmental influences and children's adaptive functioning, recognizing the strengths of diverse families from under-resourced communities. Positive and enriching experiences may promote physiological regulation and holistic wellbeing, over and above mitigating the negative effects of adversity.

Skills and experiences that may help children regulate their physiological arousal and promote more optimal responses

Researchers are examining how children's physiology response changes as they encounter, engage with, and recover from contextual challenges. This research increasingly models physiology as a dynamic process that changes over time.[40] By examining the entire trajectory of children's reactivity and subsequent recovery, researchers aim to identify patterns of physiological response that help children to thrive in the face of adversity. Although exposure to high levels of adversity may predispose many children to develop highly sensitive physiological profiles, resilient children may also develop self-regulatory skills that produce fast and efficient recovery from that arousal. For example, children with greater self-regulatory skills showed moderate levels of physiological reactivity during laboratory challenges and recovered more quickly.[41,42,43]

Related constructs such as children's executive functioning, coping and coregulation with parents are also important predictors of how children react to and recover from challenges. For example, parents' levels of hair cortisol were not correlated with their children's hair cortisol levels among children with better emotion regulation, suggesting that emotion regulation skills may mitigate transgenerational effects of ongoing physiological stress.[44] Examining how different aspects of physiological response and self-regulation work together will help illuminate processes that promote children's resilience.[6]

The field of applied developmental psychobiology is starting to consider how to leverage research about children's physiology in ways that support their wellbeing. Physiological research may elucidate how unequal educational experiences of children from historically marginalized groups affect their developmental outcomes.[6] In one study, attending child care was associated with a

suboptimal, flat cortisol response for Spanish-speaking Latine children, but having a Spanish-speaking teacher seemed to create a more supportive classroom environment that was linked to healthier cortisol response. More studies are needed to identify specific system level changes, practices and protective factors that reduce stress for children who face inequalities in treatment or access to resources.[7] Such work will help to illuminate processes that promote equity.

In addition, low-cost, scalable interventions that teach children skills for coping and self-regulating may be helpful.[45] For instance, a field experiment taught 5 to 12 year old children deep breathing skills via a short video and found that it significantly decreased their physiological activation and calmed the nervous system.[46] Children's appraisal of stressors (i.e., perceptions and beliefs) may also play a significant role in how they physiologically respond and recover.[47]

Conclusion and Implications

Resilience researchers have made significant advances in linking children's physiological reactivity to both adversity exposure and their behavioral functioning. This work has highlighted the importance of examining how the biological embedding of adversity affects children, and how the environment and children's physiological responses interact dynamically to predict development of the life course. By examining the contemporaneous association between physiological reactivity and self-regulatory skills, we may be better able to understand the resilience process for children who exhibit high physiological reactivity. Importantly, we must always remember that resilience is a dynamic process, meaning that it is malleable and changes over time.

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Resilience after Trauma in Early Development

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Introduction

The construct of resilience has been reviewed in the psychology literature for the past several decades. Only recently has this construct been applied to younger children, ages 0-5. One of the most useful conceptualizations was proposed by Masten[1] who described resilience as “ordinary magic,” that is, the idea that resilience does not require something rare or special. Rather, children and adults, even young children who are able to “bounce back” after adversities have more resources within themselves, their families and communities. Other scholars have described “minimal-impact resilience,” when there is little or no disturbance in function following an acute traumatic event.[2] For a young child, protective factors that enable a rapid recovery to pre-event adaptation levels include good functioning of key adaptive systems that normally protect child development. Although most children will show resilience and the ability to recover relatively quickly after a significant traumatic event, ongoing trauma and cumulative traumatic experiences challenge a young child’s ability to recovery.

Subject

Resilience has been described in young children following traumatic events such as witnessing community violence, domestic violence, loss of a parent due to death, multiple disruptions including frequents moves and changes in caregivers, entering into child protection systems, exposure to wars and military violence, and following natural disasters such as hurricanes, earthquakes, tsunamis, and technological disasters such as oil spills or nuclear fallout. With different types of trauma, expected reactions from young children will differ depending on the circumstances surrounding the trauma, physical and emotional availability of caregivers, and developmental factors including the age of the child.

There is increasing knowledge that brain development in early childhood is negatively impacted by exposure to trauma and neglect;[3-6] therefore, intervening in early childhood soon after a trauma

can have lasting effects for the rest of a child's lifetime. Children who have been traumatized and/or neglected have been shown to have more limited dendritic branching and less efficient neuronal pruning later in life when compared to their same-aged peers not impacted by trauma.[4] It is possible that promoting resilience in young children exposed to trauma and supporting recovery from trauma with sensitive interventions will allow them to recover and continue a normal trajectory of brain development.

Problems

The problems in studying resilience in young children come from several sources. First, many believe that young children are not impacted by trauma because they are too young to know what is happening and do not have the cognitive capacity to understand. The DSM-5 has made progress over the previous version in identifying traumatic reactions in young children.[7] The DSM-5, in acknowledging that the experience and reaction to trauma may be different for young children than it is for older children, adolescents and adults includes criteria for posttraumatic stress disorder that are specific to children under six years of age. Authors of the DSM-5 also note that although the prevalence of PTSD in young children was lower than that of adults, this may have been due to problems with the criteria in the DSM-IV not being sensitive enough to the experiences of young children. In DSM-5, additions such as irritable behaviour, expressions of reenactment through play and limitations of young children in explaining their feelings and reactions have been included to better describe this diagnosis for this younger age group. The task force for ZERO TO THREE Diagnostic Classification 0-3R,[8] among other sources, has noted that the previous definition of trauma in DSM-IV did not adequately account for situations that may be experienced by young children as traumatic, such as multiple moves, instability in the home environment and loss of a primary caregiver. As the new DSM-5 is used, it will be important for clinicians to do a careful evaluation to determine whether a young child has a traumatic response to a situation. Their disorganized or agitated responses may still be more easily overlooked than those in older children or go unnoticed until they demonstrate problem behaviours or noncompliance when confronted with reminders of the event in the future.[9-10]

Similar questions arise when defining resilience in young children. Research on understanding resilience in younger children has primarily come from downward extensions of resilience work with older children.[2,11-12] Young children are adept at resilience; however, more information about the expected trajectories of normal, traumatic, and resilient response patterns in young children following trauma are needed.[13]

Research Context

Although authors have written about resilience and response to trauma in young children,[13-14] there are only few empirical studies on resilience patterns.[15-16] Non-empirical publications have typically been based on case studies and observations[17] or downward extensions of work with older children.[1,18] Empirical studies have typically been downward extensions of studies with older children with inconsistent operational definitions and measurement of resilience.[19-21]

Key Research Questions

Research questions and areas of study regarding resilience following exposure to trauma in young children include:

- Defining trauma and resilience in young children.
- Identifying protective factors that promote resilience in young children.
- Describing the trajectories of normal, traumatic, and resilient reactions to traumatic events in young children.
- How patterns of resilience may differ across different ages and developmental levels.
- Measurement of resilience in young children.
- Best practices for promoting resilience in young children following exposure to traumatic events.

Recent Research Results on Resilience in Young Children Following Trauma

Recent research in the area of resilience in young children has focused on the areas described above. Sapienza and Masten[12] describe four waves of research on resilience in children, which can be applied to young children as well. The first wave described patterns of resilience in children. The second wave examined how some children show patterns of resilience while others were adversely affected by trauma, and the third wave sought to promote resilience through intervention and treatment. Finally, the fourth wave of research in childhood resilience attempts to achieve system level changes to promote resilience. Howell et al. recently studied differences in ratings of social competence, an index of resilience, by mothers and child therapists of preschoolers exposed to intimate partner violence in their households.[22] The authors measured resilience using the Social Competence Scale (SRS) parent and teacher versions.[23] Mothers and

therapists were found to rate young children consistently for prosocial skills; however, mothers consistently rated children as having less emotion regulation than their therapists.[22] This study highlights the importance of seeking ratings of resilience from multiple informants, as well as the need for questionnaires and standardized measures for resilience, specifically.

Many empirical studies of resilience in young children infer resilience by a lack of symptoms on scales of posttraumatic stress and better adjustment following exposure to traumatic events. Feldman and Vengrober examined posttraumatic stress symptoms in children ages 1.5 to 5 years exposed to war-related trauma living near the Gaza strip.[24] Children and their mothers were interviewed and videotaped for later coding. Videos were coded for maternal sensitivity, child secure base behaviour, and child avoidant behaviour according to a standardized and valid coding system. Children's exposure and posttraumatic symptoms were rated by their mothers; however, the scales used for the study were not standardized or shown to be valid due to a lack of prior research in this population. Posttraumatic stress disorder (PTSD) was diagnosed in 38% of children exposed to war-related trauma. Children described as resilient were those who were exposed to trauma, but did not meet full criteria for PTSD. Resilient children were found to have mothers with less symptomology for PTSD, depression and anxiety. Mothers of resilient children also rated themselves as having more social support. In coding, mothers of resilient children were found to have more sensitivity to their children during the trauma interview, and resilient children actively sought maternal support and demonstrated less avoidance during the interview than trauma-exposed children with PTSD. This study demonstrated a pattern of resilience that has been discussed in the literature for some time—resilient children often have resilient parents or caregivers with fewer psychological symptoms and strong social support networks. Parents of resilient children are also physically and emotionally available for their children and respond sensitively when their children are in distress.

Much of the extant literature describing resilience in young children arises from treatment of childhood trauma and descriptions of best practices for promoting resilience in young children exposed to trauma.[13,17,20,25-26] Treatment of young children is typically based in attachment theory. Zeanah and colleagues reviewed attachment therapies for young children[25] and found that nearly all of these treatment approaches involve both the parent and child in the treatment. Child-Parent Psychotherapy (CPP)[10] has been shown in several randomized clinical trials to be effective in helping children who have been exposed to trauma recover.[27-29] CPP involves play therapy with the parent and child in the same room and techniques individualized for each dyad designed to

promote resilience and recovery in line with goals of: 1) Encouraging a return to normal development, 2) Fostering capacity to appropriately respond to threats, 3) Establishing regular levels of affective arousal, 4) Reestablishing trust in body sensations, 5) Restoring reciprocity in intimate relationships, 6) Normalizing traumatic responses, 7) Differentiating between reliving and remembering trauma, and 8) Placing the traumatic experience in perspective.[9]

Research Gaps

While research on reactions to trauma in young children has been well-established, studies focusing specifically on resilience is still in its infancy. There have been few studies and a comprehensive review of research in the area has not been done to establish interventions and guidelines for how to promote resilience. There are no standardized measures of resilience for young children as there are for older children and adults, which makes empirical research difficult to conduct. Empirical research also has yet to examine individual differences variables that can affect resilience in young children, such as temperament and functioning level before the traumatic event. These areas are important to examine since they have been found to significantly predict resilience and development of posttraumatic stress in adults and older children.[2,30-31]

Conclusions

Factors that promote resilience following traumatic exposure include individual, situational, and caregiver variables. Caregiver variables that promote resilience include healthy psychological functioning, emotional and physical availability, and the caregiver's sensitivity to the child's emotional needs.[18,24,32-33] Situational variables that promote resilience and recovery from traumatic exposure include establishment of safety, return to normal routines following the trauma, and helping children to put the traumatic experience into a more general context of the world being a safe place.[18,34] Research has yet to fully examine the impact of individual child variables as risk or protective factors for resilience in young children following traumatic exposure. This area is potentially important given research on older children showing that anxiety symptoms prior to experiencing trauma is a risk factor for later PTSD development,[30,34] and individual strengths serve as protective factors against the development of PTSD.[19] Finally, psychotherapies based in attachment theory have been shown to help promote recovery and resilience in young children following traumatic exposure, with CPP having the strongest evidence-base.[10,27-29]

Implications for Parents or Caregivers, Services, and Policy

Current literature on resilience has implications for informing practices for children following exposure to traumatic events in early childhood. The strongest evidence for resilience supports parental characteristics, especially support and emotional availability as being most important to help young children. Following a traumatic event, parents should be encouraged to take care of themselves and their own psychological well-being, since parental psychological resilience and strong parental support systems are protective factors for young children. Parents should also try to re-establish some sense of normalcy and routine as soon as possible, although after some disasters and trauma, this may require establishment of a “new normal” if return to previous patterns and routines is not possible.[35] Parents should also ensure they provide not only physical availability, but also emotional availability and sensitivity to their children’s emotional reactions. If they are able to do so supportively, parents should listen to their children, discuss the traumatic event with them at an age-appropriate level when they are ready, and allow children to ask questions. This approach gives parents the opportunity to re-establish safety and provide reassurance for children. If parents feel unable to handle these tasks on their own and provide needed support for their children, they should seek professional help from a counselor who is trauma-informed who can help support the parent and child and, if needed, provide appropriate therapeutic treatment.

Services for children and policies affecting children after a trauma should promote the same goals described above to the extent possible. Traumatized children should be encouraged to remain with or return to their primary caregivers as soon as possible when it is safe to do so. Their environment should be one in which routines and establishment of normalcy is built into the system. If parents and primary caregivers are unable to be emotionally available to their children due to their own traumatization or stress following the traumatic experience, policies need to recognize the need for interventions both for individuals and for the child and parent together (dyadic) in order to support the relationship.

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Protective Role of Executive Function Skills in High-Risk Environments

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Introduction

There is growing evidence in the study of resilience for the protective role of executive functions in the school success of children facing adversity. Executive function (EF), also termed cognitive control, describes goal-directed abilities to control thought, behavior, and emotions.[1] These skills can be seen in the ability to retain information in working memory, sustain or shift attention, inhibit automatic responses to perform an instructed or goal-directed action, and delay gratification.

EF skills develop rapidly in the preschool period[2] and are thought to provide a foundation for cognitive and behavioural school readiness.[3] In the classroom, EF skills may manifest as the ability to pay attention, follow instructions, wait one's turn, and remember rules. These skills broadly promote positive development in multiple domains, with recent research suggesting that young children's EF skills predict resilient school and peer functioning above and beyond intelligence level and are related to better mental health outcomes.[2,4,5,6,7]

These skills may be particularly important to promote adaptive functioning for children growing up in high-risk environments. However, the development of EF skills is vulnerable to exposure to trauma and chronic stress.[8] Children from various adverse backgrounds (e.g., homeless/highly mobile, poverty, early institutionalism, maltreatment, etc.) tend to perform worse on measures of executive function.[6,9,10,11] Taken together, these findings suggest a need to lower chronic stress exposure and target building executive function skills through intervention and prevention efforts with adversity-exposed children.

Subject

High-risk youth with more developed executive function skills show better cognitive and behavioural school readiness and performance.[3,12,13] These skills appear to enable children to

navigate their constantly changing environment,[9,14] which may be especially key for children developing in environments characterized by harshness and unpredictability.[15]

However, recent research has shown that exposure high levels of adversity may undermine the development of some skills that support school readiness, including executive function.[6,7,9,10,11] These deficits may undermine children's abilities to succeed in academics and develop positive peer and teacher relationships.[12,16,17] This may have long-term implications for school success given that the achievement gap tends to persist and even widen throughout the school years.[18,19]

Given evidence that executive function skills are malleable to intervention and children who demonstrate poorer initial performance make greater gains,[20] efforts to improve high-risk children's transition to school have targeted building executive function skills prior to kindergarten.[4,21,22] Furthermore, research suggests that executive function skills are responsive to intervention across the school years.[20] It is also important to note that although children exposed to adversity tend to demonstrate lower EF skills on average, there is widespread heterogeneity, and many children manage to develop strong EF skills even in difficult circumstances.[23] Identifying and supporting existing sources of resilience, such as family and school support, that can bolster children's EF skills in high-risk environments is also essential.[24]

Problems

Studying the protective role of executive function presents several challenges. Until recently, there were few measures capable of fully capturing executive function abilities for children who are younger than four or are experiencing delays in the development of these skills. Since exposure to chronic early life stress has been linked with impaired executive function skills in some children,[8] it is critical to be able to measure a wide range in functioning to fully capture the variability in these skills. The NIH Toolbox Cognition Battery now contains two tasks with developmental extension (Dext) versions that effectively lower the floor of the standard tasks and have demonstrated concurrent, short-term, and longer-term validity.[5,13] Additionally, the Minnesota Executive Function Scale (MEFS) is an adaptive, tablet-based EF assessment that can be used with children as young as two years old.[25] Expanding the use of EF tasks that are developmentally appropriate for young children will aid in the advancement of our understanding of the protective role of these skills in early childhood.

Current interventions to improve executive function skills employ a variety of methods including training, classroom curriculum, physical activity, and mindfulness.[20,22] Though these programs suggest executive function skills are malleable, they also show varied success in skill improvements.[22,23,26,27,28,29] Programs that utilize computer-based training show promise in promoting short-term gains in targeted aspects of executive function skills; however, improvements are specific to the domain trained (e.g., working memory) and do not seem to expand to other areas of executive function more generally.[20,30] A recent meta-analysis suggests that although it is possible to foster short-term gains in children's EF skills, many of these effects may be relatively transient.[31] Approaches that involve *implicit* training of executive function, such as mindfulness training and biofeedback-enhanced regulation training, seem to be more effective than *explicit* approaches such as practice with computerized or non-computerized EF tasks.[31]

Key Research Questions

Developmental studies designed to understand the protective role of executive function often address the following questions:

- What are the mechanisms through which executive function prepares children for school success?
- What helps foster executive function skills in young children experiencing delays?
- What helps promote development of executive function skills in the context of adversity?

Recent Research Results

Research consistently indicates that children with more developed executive function skills prior to kindergarten experience greater school success.[6,7] For academic achievement, these skills may scaffold language and mathematic success.[12] In fact, in a low-income sample of children, researchers have found that executive function skills prior to kindergarten predict growth in both numeracy and literacy skills across the kindergarten year and into third grade.[12,13] In addition to providing a cognitive foundation for learning, executive function skills may also support academic success by promoting appropriate classroom behavior.[3] Many kindergarten teachers report that it is more important for children to control themselves in the classroom, follow directions, and not be disruptive than it is to know the alphabet or how to count to 20.[3] Furthermore, executive function skills may promote the development of positive teacher and peer relationships.[32,33] Studies suggest that there is overlap between the development of executive function and Theory of Mind (ToM),

which is the ability to identify that others' desires and knowledge differ from one's own. These skills are associated with lower levels of aggression, better problem-solving skills, and positive social skills.[34,35]

Recent research suggests that the nature of adversity experienced may be relevant to understanding the development of children's EF in high-risk contexts. For example, cognitive skills appear to be particularly impacted for children exposed to deprivation, such as institutional rearing or neglect, as opposed to children exposed to threat, such as child abuse or violence exposure.[36] Further, the recently articulated "hidden talents" approach advocates for a strengths-based perspective that acknowledges the development of stress-adapted skills in adversity-exposed children.[37] For example, children raised in unpredictable home environments appear to demonstrate enhanced task switching abilities, particularly under stress.[37] Additionally, children exposed to violence and poverty performed worse than their non-adversity exposed peers on EF tasks using traditional abstract stimuli, but performed equally well when more ecologically valid stimuli were used.[38] This suggests that apparent EF "deficits" may be ameliorated when children are more familiar with task stimuli. Finally, recent work has demonstrated that neighborhood resources also contribute to EF skills in preschool-aged children, over and above the effect of family resources.[39] This suggests that it may be important to consider the broader contexts where children spend time, which may present additional opportunities for interventions and policy efforts.

Research Gaps

First, much of the research on hidden talents in adversity-exposed youth has been conducted with older school-aged children and adolescents.[37] More work is needed to understand how adversity impacts the development of EF in early childhood, when domains of EF such as working memory and inhibitory control appear to be less differentiated.[40] Additionally, there is currently limited research on the effectiveness of interventions to sustain long-term gains in executive function skills with very high-risk children. It will be important to remember that intervention needs and responses of children with different experiences may differ. For children currently experiencing chronic stress (e.g., homeless/highly mobile), it is unclear whether it is feasible to target executive function skills without first reducing stress and building coping skills. Finally, researchers have begun to emphasize the role of upstream social factors, such as class- and race-based structural disadvantage, on the development of children's EF skills.[41] Efforts to mitigate structural inequality and support parents' access to resources that promote their children's development may be just

as effective as directly targeting children's EF skills through intervention. Future research will be needed to learn how best to tailor interventions and policy efforts to account for the needs of adversity-exposed children.

Conclusions

Studies consistently suggest that exposure to trauma or chronic early life stress may impact the development of executive function skills.[6,7,9,10,11] These skills appear to provide the foundation for school readiness through cognition and behaviour.[3,5,12] Because early school success is so important for later school success, it is essential to identify sources of strength that can bolster early EF skills in adversity-exposed young children.[16,17,23,24]

For this reason, there has been increased attention to interventions that promote executive function. Although there is evidence that executive function is malleable,[18,42] few interventions have attempted to boost skills in children currently experiencing toxic levels of stress. Efforts to design interventions that promote executive function in these children may need to address current levels of stress exposure and simultaneously work to reduce these to gain maximum benefit.

Implications for Parents, Services and Policy

Research to date underscores the importance of executive function skills for school success, especially for children living in high-risk environments. Programs designed to boost executive function have shown mild short-term gains across multiple levels, including school curriculum, computer-based training, and even physical activities, like martial arts.[20,43,44] Interventions that promote implicit skill gains such as teaching self-regulation strategies, self-distancing, and mindfulness may be particularly fruitful.[31,45] Additionally, parents can play a key role in fostering children's EF development. For example, autonomy-supportive parenting practices, such as providing children with choices, can promote children's EF and support their sense of self-efficacy, encouraging them to engage in more challenging tasks.[46] Furthermore, sensitive caregiving may promote EF skills by shielding children from some of the chaos they are experiencing.[47] As such, supporting parents may be an important way to indirectly bolster children's EF in high-risk contexts.[23] Executive function skills also have been successfully targeted through school-based curriculum in preschool and Head Start classrooms.[4,35] Experimental evidence suggests early childhood classrooms, like Head Start, can successfully build executive function skills by providing

more self-regulatory support in a classroom (e.g., implementing clear rules and routines, redirecting or rewarding children's behaviour).[35] Increasing attention to executive function skills in early childhood programs and increasing accessibility of these programs for adversity-exposed children may reduce the achievement gap that is apparent before school begins and persists throughout the school years.

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Gene-environment Interplay and Risk and Resilience During Childhood

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Introduction

Developmental scientists have long acknowledged that genetically-based characteristics of the child contribute to developmental processes associated with risk and resilience. For example, quantitative behaviour-genetic (e.g., twin and adoption) studies have highlighted genetic influences on children's behaviour and development, increasingly with a focus on resilience-related outcomes.[1] However, such studies often assume that genetic and environmental influences operate independently of one another. Recently, focus has shifted towards the idea that development is shaped by ongoing, reciprocal influences across multiple levels of analysis, spanning from the child's sociocultural context to molecular and cellular processes.[2-5] Studying the complex interplay between genetic and environmental influences has increasingly focused the field on the contributions of molecular variations within specific genes.

Subject

One class of gene-environment interplay is the interactions between measured genetic variations and environmental experiences. Gene-by-environment interaction (G×E) refers to the idea that genetic variations might not shape development outcomes directly but rather confer vulnerabilities and protections against the effects of adverse experience.[6] Research on G×E processes has implications for our understanding of risk and resilience because these studies have the potential to explain children's heterogeneous responses to adversity. Indeed, recent advances in our understanding and measurement of molecular genetic variations have ushered in a growing number of genetically informed investigations of risk and resilience in children's development.

Research Context

To date, research on G×E processes has focused on a relatively small but expanding number of genetic variations. Moreover, nearly all of the genetic markers investigated to date transcribe

proteins that regulate the availability and functioning of neurotransmitters such as serotonin, dopamine, and norepinephrine. In this way, current G×E research has emphasized the idea that the effects of adverse experiences on later adaptation and functioning may be, at least partially, accounted for by neurobiological processes.[7,8]

Key Research Questions

Although children may experience many kinds of adversity, maltreatment is one that has been observed to overwhelm the child's adaptive capacities, therefore leading to a host of problematic developmental outcomes.[9,10] However, not all maltreated children develop maladaptively. Some abused and neglected youth function in a competent manner despite the pernicious experiences they have encountered. Recent investigations have begun to shed light on how G×E processes may account for the variability in outcomes associated with child maltreatment.[11-16]

Recent Research Results

In a groundbreaking study, Caspi and colleagues reported that a functional variation in the gene encoding the neurotransmitter-metabolizing enzyme monoamine oxidase A (MAOA) moderated the consequences of child maltreatment on later antisocial behaviour.[11] More specifically, individuals who experienced maltreatment were at an increased risk for antisocial behaviour if their genotype conferred low levels of MAOA expression. There were no associations between MAOA genetic variation and antisocial behaviour in the absence of maltreatment. Thus, the combination of genetic vulnerability and childhood maltreatment posed the greatest risk for antisocial outcomes. In a second study, Caspi and colleagues observed that individuals carrying one or two copies of the less efficient version of a serotonin related genetic marker exhibited more depressive symptoms following childhood maltreatment compared to maltreated individuals with the more efficient version.[12] Once again, genetic variations were not associated with mental health outcomes among individuals who had not experienced maltreatment earlier in development.

Subsequent attempts to replicate these findings in independent samples have not produced a uniform body of evidence, thus sparking a debate about the magnitude and replicability of G×E effects for children's development.[17-20] However, consensus is building around the possibility that measurement issues play a critical role in researchers' ability to detect G×E effects.[21] For example, recent longitudinal studies that include prospectively collected information about child

maltreatment have supported the hypotheses that MAOA and serotonin transporter genetic variations moderate the associations between child maltreatment and antisocial and depression outcomes, respectively.[13-16] For both developmental outcomes, the maladaptive consequences of child maltreatment are most pronounced among genetically susceptible individuals. These results have ushered in a wave of research interest in the possibility of G×E effects involving other child development outcomes and other types of stressors.[22] However, the findings from many of these studies have not yet been thoroughly replicated, so the prevalence of G×E effects for children's development remains uncertain.

One exciting new avenue for research on genetic contributions to risk and resilience is the possibility that children's genetic characteristics moderate the effectiveness of preventive interventions. For example, Bakermans-Kranenburg and colleagues reported that children's genotype moderated their responses to an intervention designed to reduce children's behaviour problems by training parents to provide responsive care and sensitive discipline.[23] Children who were randomly assigned to the intervention showed significant reductions in externalizing behaviour problems compared a control group only if they carried the less efficient version of a dopamine-related genetic marker. This finding, among others, points to the possibility that genotypic differences may contribute to children's differential responses to positive interventions as well as adversities.[24,25] Future research in this area may uncover avenues of tailoring prevention and intervention efforts to the needs of the individual.

Research Gaps

Altogether, the studies of gene-by-environment interactions are beginning to shed light on genetic factors that might moderate the impact of early adverse experiences for children's behavioural and mental health. However, this is still a new research area and several gaps remain. First, many of the findings still await thorough replication. This is important because molecular genetic investigations have generally been difficult to replicate in both the biomedical and psychological sciences.[26,27] Corroborating evidence from diverse samples is vital to the development of empirically supported interventions and preventions. Second, it has been argued that some genetic variations confer increased susceptibility to all contextual influences, not only adversity.[22] According to this perspective, genetic variants formerly viewed as vulnerability factors may actually heighten susceptibility to positive environments as well. If confirmed, this would have far-reaching implications for our understanding of genetic contributions to risk or resilience.

Conclusions

Increased knowledge about the genome promises to elucidate how children's resilience in the face of adversity is shaped by the complex interplay between their genetic makeup and experiences. In particular, the research on gene-by-environment interactions indicates that genetic variations may not have direct associations with children's developmental outcomes but instead predispose individuals to be especially susceptible to the harmful effects of adversities such as child maltreatment. Although the available evidence is still limited in some respects, this area of research has already begun to enhance our understanding of children's heterogeneous responses to their experiences. Still, it is important to remember that the processes of resistance and recovery from adversity are shaped by multiple factors, not just the child's genetic makeup. As such, the risks associated with an individuals' genome or early childhood experiences may be buffered by experiences later in life.[28] Also, the interplay between genetic and environment factors involves more than just gene-by-environment interactions. Another type of interplay that is receiving increased attention among developmental researchers is the environmental regulation of genomic functioning, a phenomenon referred to as epigenetics.[29] Although research in this area is still in its infancy, investigations of epigenetic modification may shed light on neurobiological mechanisms by which early adverse experiences exert a detrimental influence on children's adaptation across the life-course.

Implications

The hope for many involved in research on gene-environment interplay is that increased knowledge of genetic contributions to risk and resilience will eventually yield practical applications for prevention and intervention programs aimed at reducing the burden of mental illness and improving the quality of life for individuals in higher risk contexts. For example, genetic information could potentially be used to identify and selectively target individuals who are at the greatest risk for problematic outcomes. In addition, it may be possible in the future for intervention and prevention programs to customize their treatment protocols based on each individual's genotype. However, scientific understanding remains a long way from being able to make suggestions about how to tailor interventions to specific groups of children on the basis of genotype. Nonetheless, advances in our conceptual understanding of the factors (genetic and otherwise) that account for individuals' varied responses to their environments will provide clues for aiding efforts that treat the wide range of problems associated with childhood adversity.

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