

Children and Climate Change: Introducing the Issue

Janet Currie and Olivier Deschênes

According to the US National Oceanic and Atmospheric Administration, 2015—with an average global temperature 1.6° Fahrenheit warmer than the twentieth-century average—was Earth’s warmest year since record keeping began in 1880, continuing a half-century-long trend of rising temperatures. The debate about climate change and appropriate policy response is often framed in terms of the likely impact on our children. Children born in 2016 will be 34 in 2050 and 84 in 2100. How will the probable rise in temperature (3.6 to 7.2° Fahrenheit, or 2 to 4° Celsius), rising sea levels, and the increasing likelihood of extreme weather affect the course of their lives and the lives of their children? This issue of *The Future of Children* outlines the likely consequences of climate change on child health and wellbeing and identifies policies that could mitigate negative impacts.

Four interrelated themes emerge from the issue.

1. Climate change will fundamentally alter Earth’s climate system in many ways that threaten children’s physical and mental wellbeing.
2. Today’s children and future generations will bear a disproportionate share of the burden of climate change, which will affect child wellbeing through many direct, indirect, and societal pathways.
3. Children in developing countries and countries with weak institutions face the greatest risks.
4. The uncertainties associated with climate change and its mitigation—coupled with the fact that the costs of climate change mitigation policies need to be paid now, but the benefits will accrue in the future—make it difficult to enact appropriate policies.

In the past decade, the science of climate change has progressed rapidly. By combining evidence from direct observation, climate modeling, and historical sources (such as ice cores that can reveal information about climate centuries ago), scientists have become virtually certain that human activities are altering our climate in ways that will have drastic effects for future generations through mechanisms such as sea-level rise, warmer

www.futureofchildren.org

Janet Currie is the Henry Putnam Professor of Economics and Public Affairs, chair of the Department of Economics, and director of the Center for Health and Wellbeing at Princeton University. Olivier Deschênes is an associate professor in the Department of Economics at the University of California, Santa Barbara.

temperatures, and a higher frequency of natural disasters.

Children are largely left out of discussions about appropriate responses to climate change, but they ought to be central to these debates because they—as well as future generations—have a much larger stake in the outcome than we do.

Compared with adults, children are physically more vulnerable to the direct effects of extreme heat, drought, and natural disasters. Climate change's indirect effects can also derail children's developmental trajectories—for example, through conflict, vector-borne diseases, economic dislocation, undernutrition, or migration—making it harder for them to reach their full potential. As some of the most vulnerable members of society, children generally suffer whenever there is social upheaval. Given the profound changes to society that may accompany climate change, it is likely that children will be especially severely affected.

Our third theme is that children are especially vulnerable in developing countries, where 85 percent of the world's youth currently live. Children in those countries are already facing the impacts of climate change. The World Health Organization estimates that children suffer more than 80 percent of the illness and mortality attributable to climate change. So, for a large share of the world's population, climate change is here and now and not merely some future problem. Moreover, to the extent that children in developing countries are already more likely to face other threats to their health and welfare, they may have less resilience to confront the additional problems caused by climate change.

At the same time, given that so many factors contribute to children's development, there

may be many ways to either exacerbate or compensate for the harm caused by climate change. Governments bear major responsibility for adopting policies that respond to climate change. However, governments in developing countries are less likely to represent children's interests effectively, leaving children at even greater risk of harmful consequences.

Our fourth theme is that decision making surrounding climate change is greatly complicated by the high degree of uncertainty involved in virtually all of its aspects. Yet waiting for uncertainty to be resolved before acting is not a viable option, given the risk of allowing irreversible changes to the planet to be “baked in.” Climate science has made great strides in recent years, but estimates of climate change's likely effects still span a broad range, and it's important to consider worst-case scenarios as well as median forecasts.

Just as important is the uncertainty surrounding human responses to climate change. Technology can help us both mitigate climate change (for example, by capturing and storing carbon emissions or increasing our reliance on renewable energy) and adapt to it (via cooling technologies such as air conditioning, changes in urban building design, flood control, and so on). Individual behavioral responses, such as migrating or spending more time indoors, also represent possible adaptations to climate change. Moreover, such responses can work either to prevent the effects of climate change or to mitigate them after the fact. But until we invest in, develop, and disseminate new technologies, it's impossible to know how well they would work or how much they would cost. And it's still uncertain whether governments have the political will to act, though the 2015 Paris Agreement was

encouraging in that respect; adopted by all 195 member states of the United Nations Framework Convention on Climate Change, it laid out a framework for each country to reduce carbon emissions based on a national target.

Overall, then, even if we knew the precise magnitude of future shifts in global climate, we would still have trouble forecasting the likely effects on children. Much of what we know about, for example, the effects of high temperatures on children comes from extrapolating from short-term variations in weather to long-term variations in climate. In the short term, though, our capacity to adapt to, compensate for, or reinforce such effects is limited. Thus estimates based on short-run variations could either overstate or understate the likely longer-term effects of climate change.

A related problem is that it's hard to identify the causal impacts of changes in weather or climate. Correlation is not causation, in part because many factors typically change at the same time, and some of them may not be captured in the types of data we study. If, for example, a local drought coincided with a global drop in the production of a locally grown commodity, we might erroneously attribute negative economic effects to the drought rather than to global markets. Similarly, if everyone living in a floodplain were moved to higher ground, then increases in periodic flooding due to climate change wouldn't mean greater loss of life or property. However, the move itself would involve costs and foregone opportunities, and those costs would ideally be considered costs of climate change. Throughout this issue of *The Future of Children*, then, we asked authors to pay careful attention to the credibility of the available causal evidence and the extent to which that evidence captures all of the

relevant costs and benefits of climate change, including those caused by adaptation or mitigation efforts.

Findings of the Issue

Here we highlight key findings from the individual articles.

The opening article, "The Science of Climate Change," by Michael Oppenheimer and Jesse Anttila-Hughes, offers a primer emphasizing the features of climate change that are likely to have the greatest impact on children. Oppenheimer and Anttila-Hughes consider four broad sources of knowledge about climate change: direct observation of weather and climate records over time; paleoclimate work based on such things as ancient tree rings or air bubbles trapped for thousands of years in Antarctic ice; chemical and physical analysis; and climate modeling. One broad conclusion is that although climate change will be felt globally, its effects will be very different in different places. Overall, however, the effects of climate change on human wellbeing—either directly, through exposure to changing climate, or indirectly, through climate-induced changes in society and the economy—are predicted to be extremely negative. A moderate example comes from studying the El Niño phenomenon, a relatively mild periodic climate shock that causes a great deal of disruption globally, with local effects that range from torrential rains to heat waves to droughts. The likely effects of climate change include changes in the distribution of temperature toward greater warmth, hydrologic stress and a resulting increase in food insecurity, more-frequent extreme weather events, sea-level rise, and damage to ecosystems. The long atmospheric life of most greenhouse gases that cause climate change—hundreds to thousands of years—

combined with the lag between actions to reduce the extent of climate change and their effects, suggests that our children and our children's children are already on track to suffer those effects.

In the second article, Joshua Graff Zivin and Jeffrey Shrader zero in on how rising temperatures (global warming) affect children. They review evidence that high temperatures increase mortality, especially among fetuses and young children (as well as the elderly). When combined with other conditions—such as high humidity, disease vectors, or pollution—heat can be even deadlier. And even when it isn't fatal, exposure to high temperatures reduces learning and worker productivity. Graff Zivin and Shrader also discuss a range of policy responses—from air conditioning to better preparation for emergencies—that could mitigate those effects.

In the next article, Richard Akresh considers the relationship between conflict and climate change. A growing contingent of researchers has been examining the relationship between climate shocks, especially higher temperatures and extreme weather events, and conflict at all scales, from interpersonal violence to war. Children are especially vulnerable to conflict and suffer impacts from exposure in the short, medium, and long term. Akresh discusses evidence that those effects can spill over to the next generation and beyond, leaving long-run damage to the affected countries' ability to develop human capital. In addition to its direct effects, conflict generally leaves many additional problems in its wake, including malnutrition, famine, disease, and economic and social dislocation. Akresh points out that conflict is a great leveler in that its negative effects are seen among both rich children and poor

children, among boys as well as girls, and in all stages of childhood.

Carolyn Kousky focuses on how children may be affected by the increased frequency of natural disasters that climate change is expected to produce. Kousky considers three types of harm: negative health impacts, interruption in schooling, and negative psychological impacts. Disasters can harm children's physical health disproportionately—for example, through malnutrition or diarrheal illness—and can decrease access to medical care even for non-disaster-related illnesses. Like conflicts, disasters can displace populations, destroy school facilities, and push families to send children into the labor force to help with the economic shock the disaster causes. Finally, the trauma of disasters can cause mental health problems later on. Kousky notes that children living in low-income areas are particularly vulnerable to a disaster's effects.

Allison Larr and Matthew Neidell's article explores the complex relationship between pollution and climate change, as well as the relationship between pollution and children's health and human capital development. Many people assume that policies to reduce climate change will also reduce pollution (and vice versa), but that's not necessarily the case. Concentrations of some ambient pollutants are linked to temperature and other climatic variables through complex, nonlinear relationships. As a result, higher temperatures caused by global warming may increase ozone levels, but the increased rainfall that's predicted to occur in some areas could reduce levels of particulate matter in the atmosphere. On the other hand, fossil fuel power plants are major sources of carbon dioxide, but they also emit high levels of nitrogen dioxide and sulfur dioxide—which play a role in forming ozone

and particulate matter—suggesting that if we reduced fossil fuel consumption, we would not only reduce emissions of greenhouse gases but also reduce ambient pollution. In that way, Larr and Neidell project, mitigating the emissions that produce climate change would produce significant improvements in child wellbeing. More children would survive into adulthood, experience healthier childhoods, have more human capital, and be more productive as adults. The authors' calculations focus exclusively on the United States, which has the most-complete data available to make such calculations. Yet, they point out, the expected costs of climate change are likely to be largest in developing countries.

Rema Hanna and Paulina Oliva delve into the likely implications of climate change for children in developing countries. Such children already face severe challenges, which climate change will likely exacerbate. In particular, most people in developing countries still depend primarily on agriculture as a source of income, and so anything that reduces crop yields is likely to directly threaten the livelihoods of developing-country families and their ability to feed their children. Children in developing countries also face more-severe threats from pollution of both the air and the water and from water- and vector-borne diseases. And the fact that many developing countries have high birth rates and high ratios of children to adults (known as *high dependency ratios*) means that proportionately more children are at risk in developing countries.

In their article on the costs of mitigating climate change, Billy Pizer, Ben Groom, and Simon Dietz lay out a framework for thinking about the costs and benefits of climate change policies. A central question, given that climate change is a multigenerational

problem, is that of who should pay the costs relative to who will reap the benefits. For example, one formulation of the problem is that the current generation must pay to reduce the risks of climate change for future generations. But depending on the progress of technology and economic growth, it might well be the case that future generations will be much wealthier than we are; if so, perhaps it's not fair to demand that current generations pay. That type of trade-off is at the heart of discussions about whether current children in developing countries should pay for climate change policies, as they would if measures are adopted that reduce current economic growth. Another difficult issue has to do with how to value the welfare of generations that are yet unborn and that may never be born in some possible states of the future world. In their discussion of those issues, the authors bring to bear insights from burgeoning research on intergenerational equity and the appropriate way to discount future costs and benefits.

The last article, by Joseph Aldy, describes the political economy that underlies the current state of global efforts to mitigate climate change. Aldy frames the political challenge associated with crafting a meaningful climate policy in the context of a model of business capital and societal capital that includes the environment and global climate as components of societal capital. A key implication of Aldy's framework is that the near-term costs of climate change mitigation will be borne disproportionately by the owners of existing business capital—especially incumbent firms in fossil-fuel-intensive sectors—whereas the benefits of such policies would accrue primarily to future generations.

Aldy argues that the current lack of a national climate change policy in part

reflects this distributional imbalance in costs and benefits. He then draws lessons from successful US policy reforms in the past whose costs and benefits accrued to different groups. His analysis highlights some of the key characteristics of long-term, durable, successful public policies in American history—for example, the 1935 Social Security Act and the 1970 Clean Air Act Amendments. Those policies addressed contemporary problems that were already imposing direct costs on a significant portion of the population. A major difference between such policies and effective climate policy is that those past policies tackled domestic issues, whereas climate change is a global problem that will require some form of coordination across countries. The recently adopted Paris Agreement is an example of a promising policy framework centered on multilateral collaboration and engagement.

Implications for Research and Policy

The effects of global climate change on child wellbeing are expected to be extensive, geographically varied, and, to a large extent, reinforced by current economic and social inequities. On June 25, 2013, while announcing his Climate Action Plan, President Barack Obama said: “Someday, our children, and our children’s children, will look at us in the eye and they’ll ask us, Did we do all that we could when we had the chance to deal with this problem and leave them a cleaner, safer, more stable world?”

The findings in this issue have clear implications for researchers and policy makers trying to tackle the many challenges climate change poses.

1. The continuous emission of greenhouse gases since the dawn of the Industrial Age has already begun to alter the global climate system, and it will continue to do so even if we significantly reduce global emissions. Establishing a large-scale international and coordinated policy response has proven difficult. Children and future generations lack a presence in the debate. The 2015 Paris Agreement, the positive outcome of more than 20 years of international climate negotiations, may prove to be a fundamental step in addressing the threat of climate change, but at best we won’t know whether it’s effective until two to three decades from now. This state of affairs highlights the fundamental uncertainty that characterizes the issue of climate change as well as the need to find a way to act despite that uncertainty.
2. Even as we increase our efforts to reduce emissions of greenhouse gases that cause climate change, the climate system will continue to grow warmer for a significant period of time. Thus policies must be developed to prepare and adapt in the face of inevitable climate change. States, cities, and communities all over the world must promote preparedness and resilience. For example, the 2015 Paris Agreement includes a plan to give developing countries \$100 billion a year to adapt to and mitigate the impacts of climate change. In the United States, federal agencies have released adaptation plans that lay out strategies to protect their programs from the effects of climate change.
3. Large-scale adaptive responses to climate change entail significant societal impacts. For example, in 2008, extreme weather events displaced 20 million people. Future forecasts suggest that by 2050 there could be 200 million environmental migrants, many of whom could be

children. Countries and communities need to prepare for such possible large-scale relocation of poor and vulnerable populations. The 2015 European migrant crisis highlights the complex and difficult nature of responding appropriately to such mass migrations.

4. We need additional public health investments and interventions to educate people about the risks climate change poses to children and to protect individuals and communities from its effects. Advance warning of excessive heat, outreach, and air-conditioned cooling shelters and community centers have succeeded in mitigating the impact of extreme heat. Education and warnings are especially important because the populations most vulnerable to the health effects of climate change are young children and the elderly. Climate change may therefore place increased demands on already financially fragile public policies such as Medicare and Medicaid. In another vein, although the US Environmental Protection Agency's Indoor Air Quality in Schools program includes the maintenance of acceptable temperature and relative humidity in

its definition of good indoor air quality management, no federal standard establishes maximum temperatures in schools. Based on the evidence in this issue, temperature standards or air-conditioning requirements for schools would provide sizable benefits, especially for children in disadvantaged urban communities.

5. We need more research across the entire spectrum of disciplines, from improving climate science and climate modeling to better measuring climate change impacts and identifying possible adaptation strategies to developing new methods for effective decision making in the face of long time horizons and deep uncertainty. Both the public and the private sector must stimulate additional research by funding new initiatives and by collecting and disseminating the required data.

United Nations Secretary-General Ban Ki-moon has called climate change “the defining challenge of our age.” The 2015 Paris Agreement gives us reason for cautious optimism, but only time will tell whether that optimism is justified.