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Childhood Development and Access to Nature:

A New Direction for Environmental Inequality Research

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Abstract

Although environmental inequality researchers have increased our understanding of race- and class-based environmental inequality in many important ways, few environmental inequality studies ask whether children are disproportionately burdened by environmental pollution or whether poor and minority youth are less likely than their White and wealthier counterparts to spend time in green spaces and the natural world. This gap in the literature undermines the ability of researchers to fully understand and explain environmental inequality. To demonstrate the importance of filling this gap, the authors (a) highlight current research findings from the environmental health, environmental education, and environmental psychology literatures regarding the cognitive, emotional, and physical importance of childhood exposure to nature and (b) summarize the few existing studies that have examined class- and race-based inequalities in children's exposure to the natural world *and* industrial environmental hazards. The authors then suggest several avenues of research that would, if undertaken, significantly increase our understanding of youth-based environmental inequality. By synthesizing findings across multiple disciplines, the authors hope to convince environmental inequality researchers of the importance of investigating children's differential exposure to nature, green spaces, and industrial environmental hazards.

Keywords

environmental inequality; childhood development; green space; access to nature; youth

In recent years, environmental inequality researchers have conducted numerous studies to determine whether poor people and racial and ethnic minorities are disproportionately burdened by residential proximity and exposure to environmental hazards (Bowen, 2002; Brulle & Pellow, 2005; Downey, 1998, 2003; Mohai & Bryant, 1992; Morello-Frosch, Pastor, & Sadd, 2001; Pellow & Brulle, 2005; Pellow & Park, 2002). Although this research has increased our understanding of race- and class-based environmental inequality in many important ways, it largely disregards the question of whether other subordinate groups, in particular children, are disproportionately burdened by, or vulnerable to, environmental inequities (Downey, 2005a; Shibley & Prosterman, 1998; for exceptions, see Bullard, 1983; Grineski, 2006; Pastor, Sadd, & Hipp, 2001; Pastor, Sadd, & Morello-Frosch, 2002; Stretesky & Lynch, 2002). Moreover, despite the dual emphasis in early environmental justice activism on subordinate groups' overexposure to pollution *and* underexposure to nature and green spaces (Downey, 2005b), few studies examine race or class inequities in access to nature and green space.

Although proximity to nature and exposure to green spaces may seem negligible compared with unequal pollution exposure and disparate proximity to toxic hazards, recent findings indicate that limited exposure to nature and green space may have serious physical and psychological health ramifications (Faber Taylor & Kuo, 2006; R. Kaplan & Kaplan, 1989; S. Kaplan, 1995; Kellert, 2005). Moreover, research suggests that children disproportionately suffer the long-term developmental consequences of limited experiences in nature (Kellert, 2005), making it imperative that environmental inequality researchers place children and their differential contact with and experiences in nature at the forefront of their research.

To make this case, this article highlights current research findings from the environmental health, environmental education, and environmental psychology literatures regarding the cognitive, emotional, and physical importance of childhood exposure to nature. This article also summarizes the few studies that have examined class- and race-based inequalities in children's exposure to the natural world *and* industrial environmental hazards. By synthesizing findings across multiple disciplines, we ultimately seek to provide a solid foundation for understanding the central environmental inequalities facing children and aim to convince environmental inequality researchers of the importance of investigating children's differential exposure to nature, green spaces, and industrial environmental hazards.

Incorporating environmental health, environmental education, and environmental psychology research into the larger body of environmental inequality studies is important for several reasons. First, it is widely accepted that children are more vulnerable than adults to the negative effects of environmental toxins because of the fundamental differences in children's physiology, metabolism, absorption, and exposure patterns that cause children's bodies to react to and excrete toxins differently than adults (Crom, 1994; Pastor et al., 2002). Second, increasing evidence suggests that access to nature and green space provides children with a myriad cognitive, emotional, and physical benefits, such as increased ability to concentrate, improved academic performance, reduced stress and aggression levels, and reduced risk of obesity (Faber Taylor & Kuo, 2006; Kellert, 2005; Lieberman & Hoody, 1998; Louv, 2007; Wells & Evans, 2003). Thus, recent scholarly evidence and the proliferation of popular media reports on the importance of outdoor play have sparked national concerns about the long-term consequences of children's diminished contact with nature, ultimately generating a nationwide movement to "leave no child inside" (American Public Health Association, 2007; Frumkin & Louv, 2007; Louv, 2007; St. George, 2007).

Third, unprecedented numbers of children in the United States suffer from asthma, cancer, low IQs, and learning disabilities each year (American Lung Association, 2007; Center for Health, Environment, and Justice, 2001; Louv, 2005). Although there is still much uncertainty as to the direct and indirect causes of these alarming health trends, current findings from the environmental psychology and environmental health fields are beginning to link children's exposure to environmental pollutants and diminishing access to nature to children's declining mental and physical health (Faber Taylor, Kuo, & Sullivan, 2001; Goldman & Koduru, 2000; Petty, Peacock, Sellens, & Griffin, 2005; Senier, Mayer, Brown, & Morello-Frosch, 2007; Wells, 2000). It is critical, therefore, to determine whether poor and minority children are more likely than their White and wealthier counterparts to be exposed to toxic pollutants and whether they are less likely to have contact with and experiences in the natural world. Determining whether such inequalities exist has potentially important public health, educational, environmental, and labor market implications and will contribute greatly to the large body of research on race- and class-based health disparities in the United States.

Fourth, research has shown that regardless of race, ethnicity, and socioeconomic status, early childhood experiences in nature significantly influence the development of lifelong environmental attitudes and values (Chawla, 1998, 1999, 2006a, 2006b; Wells, 2000). However, mounting evidence shows that American children are spending less and less time in the natural world (Hofferth & Curtin, 2006; Hofferth & Sandberg, 2001). As a result, many educators, environmentalists, scholars, and parents are becoming increasingly concerned about whether today's "de-natured" children will want to protect and care for the natural environment (EcoAmerica, 2006; Louv, 2007; Pyle, 2002; White, 2004). Because race and class inequalities likely influence children's access to, attitudes about, and behaviors regarding the environment (Chawla, 2001; Hart, 1979; Kahn & Friedman, 1995; Schultz, Unipan, & Gamba, 2000; Wals, 1994), it is critical to examine which youth populations are marginalized from daily experiences in nature and to determine which barriers to such experiences these youth face. Such information can help environmental educators, urban planners, and environmental organizations understand what is needed to foster youth's reconnection to nature as well as how to build environmental concern across racial, ethnic, and socioeconomic boundaries.

Fifth, evidence suggests that the American public is more concerned about children's health, safety, and general well-being than it is about other social concerns (Lucile Packard Foundation for Children's Health, 2007). Thus, demonstrating the existence of race and class differences in children's access to nature and exposure to toxic pollutants may encourage broader public support for policies designed to overcome environmental inequality than will research that demonstrates the existence of environmental inequality across all age groups.

Finally, the negative impact of pollution exposure and limited access to nature on children's educational achievement, cognitive functioning, and mental health has serious implications for the future economic success of the United States in a highly competitive global market (Center for Health, Environment, and Justice, 2001). Therefore, focusing research efforts on children may be particularly useful in encouraging public policies and regulatory change dedicated to reducing pollution emissions, increasing access to nature and green spaces, and overcoming the pernicious effects of environmental inequality.

In the following section, we review the literature on environmental inequality, highlighting the few studies that have focused on youth exposure to environmental pollutants. We then discuss the negative impact that diminished contact with nature has on children's mental, physical, and emotional development and children's environmental attitudes and behaviors. We tie these sections together by reviewing the limited number of studies that ask whether poor and minority children have fewer nature experiences and less access to nature than do White and nonpoor children and conclude by discussing several avenues of future research that we believe can significantly increase our understanding of youth-based environmental inequality. Conducting such research will not only expand our understanding of youth-based environmental inequities, it will also generate new questions regarding barriers to healthy childhood development, especially in low-income and minority communities.

The Environmental Inequality Literature

Environmental inequality researchers have studied the distribution of social groups around a variety of environmental hazards, including hazardous waste sites, manufacturing facilities, superfund sites, chemical accidents, and air pollutants (Bowen, 2002; Derezinski, Lacy, & Stretesky, 2003; Downey, 2005b; Morello-Frosch et al., 2001). Researchers have found income and poverty to be consistently associated with hazard presence in the expected direction: As environmental hazard presence increases, incomes tend to decrease and

poverty rates tend to increase (Chakraborty & Armstrong, 2001; Derezinski et al., 2003; Hamilton, 1995; Krieg, 1995; Lester, Allen, & Hill, 2001; McMaster, Leitner, & Sheppard, 1997; Mohai & Bryant, 1992; Morello-Frosch et al., 2001; Oakes, Anderton, & Anderson, 1996; Ringquist, 2000; Smith, 2007; Stretesky & Hogan, 1998).

Findings regarding the existence of environmental racial inequality have been less consistent (Downey, DuBois, Hawkins, & Walker, in press). Many studies have found strong evidence of environmental racial inequality (Downey, 1998, 2003; Hamilton, 1995; Krieg, 1995; Mohai & Bryant, 1992; Morello-Frosch et al., 2001; Ringquist, 2000; Stretesky & Hogan, 1998; Stretesky & Lynch, 2002), some have found evidence of environmental racial inequality for some minority groups but not others (Brown, Ciambrone, & Hunter, 1997; Downey, 2006a,b; Pastor et al., 2002; Sadd, Pastor, Boer, & Snyder, 1999), and some have found only weak evidence of environmental racial inequality, inconsistent evidence, or no evidence at all (Anderton, Anderson, Oakes, & Fraser, 1994; Anderton, Anderson, Rossi, et al., 1994; Atlas, 2002; Bowen, Salling, Haynes, & Cyran, 1995; Clark, Lab, & Stoddard, 1995; Derezinski et al., 2003; Oakes et al., 1996). Nevertheless, most studies support the claim that environmental racial inequality is a serious social problem in the United States (Brulle & Pellow, 2005; Downey, 2007; Ringquist, 2005).

Although environmental inequality researchers have focused much attention on race- and income-based environmental inequality, only a few researchers have investigated environmental inequality as it relates to children and youth. This is surprising because research suggests that children, especially young children, are more susceptible than adults to the negative health effects of toxic pollution (Bearer, 1995; Crom, 1994; Guzelian, Henry, & Olin, 1992; Landrigan, 2004; Pastor et al., 2002). Children are more vulnerable than adults to environmental toxins in large part because of their relatively high ratio of skin surface area to body weight and because on a weight for weight basis children eat more food, drink more water, and breathe more air than do adults (Crom, 1994). In addition, because children's organ systems are in a constant state of development, "children absorb, metabolize, detoxify, and excrete poisons differently from adults" (Center for Health, Environment, and Justice, 2001, p. 14).

Not surprisingly, the few environmental inequality studies that have examined children and youth have found race and class inequities in the distribution of youth around environmental hazards. For example, Stretesky and Lynch (2002) demonstrate that in Hillsborough County, Florida, predominantly Black schools are located closer to hazardous waste sites than are predominantly White schools and that those schools that are proximate to hazardous waste sites are becoming more racially segregated over time. Similarly, Pastor et al. (2002) show that in the Los Angeles Unified School District (LAUSD), minority students are more likely than White students to attend schools that are proximate to hazardous waste facilities. Minority students in the LAUSD also face higher cancer and respiratory health risks from air toxics at school than do White students (Pastor et al., 2002). In addition, controlling for indoor and outdoor environmental conditions in Phoenix, Arizona, Grineski (2006) found that zip codes with higher percentages of African Americans had higher rates of hospitalizations from asthma than did other zip codes. Moreover, exposure to both poor indoor air quality and ozone were significant predictors of asthma hospitalizations among children. Grineski points out the double jeopardy that poor indoor and outdoor air quality pose for asthmatic children, stating that "poor asthmatic children in Phoenix often live in dilapidated rental homes located near freeways with mold, old carpet, and dusty yards" (Grineski, 2007, p. 369).

Although environmental inequality researchers have conducted several important studies regarding the demographic inequities in children's exposure and proximity to environmental

hazards, the bulk of this research is found within the environmental health sciences literature. Many environmental health studies, for example, have examined the relationship between children's exposure to environmental toxins and poor-quality housing and schooling. Not surprisingly, results indicate that exposure to environmental toxins such as lead, polychlorinated phenols, and organophosphate pesticides are differentially concentrated in areas where minority and poor children live and go to school (Duncan & Brooks-Gunn, 1997; Friedrich, 2000; Hood, 2005; Markowitz, 2000; Pirkle et al., 1998; United States Environmental Protection Agency, 2007). For instance, assessing blood samples from children living in socioeconomically disadvantaged areas of Minneapolis, Sexton et al. (2006) found that cumulative exposure to environmental carcinogens and neurotoxins, such as pesticides and volatile organic compounds, were comparatively high for children from poor inner-city neighborhoods. Nevertheless, Sexton et al. (2006, p. 453) note that with the exception of lead, "little is known about health effects resulting from exposures to hazardous environmental chemicals for children of all ages, backgrounds, and circumstances."

Children living and going to school in poor-quality conditions are disproportionately exposed to other environmental pollutants as well. For example, dilapidated housing and schooling conditions are associated with poor indoor air quality, increasing children's exposure to asthma triggers, such as mold, dust mites, and moisture (Hood, 2005). Such poor-quality conditions are also associated with increased exposure to mental health stressors, such as violence, crime, and social seclusion (Center for Health, Environment, and Justice, 2001; Frumkin, 2005; Hood, 2005). Moreover, studies have shown that children in poor neighborhoods and schools tend to be disproportionately proximate to emissions from surrounding industrial plants and highways, which exacerbates asthma and increases lifelong cancer risks (Loh, Sugerman-Brozan, Wiggins, Noiles, & Archibald, 2002; Northridge, Stover, Rosenthal, & Sherard, 2003).

In sum, these studies suggest that both poor and minority youth are disproportionately exposed to numerous environmental risks. However, the evidence is limited and much of this research comes from the public health rather than the environmental inequality literature, suggesting that these two literatures need to be linked and that environmental inequality researchers need to directly examine race and class disparities in children's exposure and proximity to environmental hazards. In the next two sections, we extend this argument by highlighting the important role that access to green space and experiences in nature play in youth development and well-being. Our goal in doing this is to demonstrate that race and class differences in youths' access to nature and green spaces represent another potentially important form of environmental inequality and that the environmental inequality literature would be enriched not only by studying these differences but also by incorporating insights and findings from the environmental health, environmental education, and environmental psychology literatures regarding the cognitive, emotional, and physical importance of childhood exposure to nature.

Children's Access to Nature

Increased urbanization combined with dwindling natural spaces and increased time indoors has sparked recent concerns regarding children's diminishing direct contact with nature (Louv, 2005; Wells & Lekies, 2006). Evidence that children are spending more time indoors and less time in nature (Chawla, 2006b; Davis, 1999; Hofferth & Sandberg, 2000; Louv, 2007; Pyle, 2002) has also sparked research across the health and psychological sciences that links children's diminished contact with nature to important childhood health trends, including increased levels of depression and increased incidences of cognitive disabilities, obesity, and diabetes (Louv, 2005). This research indicates that exposure to nature has

physical, mental, emotional, and cognitive benefits that not only buffer the symptoms of the above disorders but also positively affect children's overall development (Chawla, 1998; Kellert, 2002, 2005; Louv, 2005; Wals, 1994; Wells & Lekies, 2006). We summarize this literature below, starting with a brief review of research that demonstrates that children are spending more time indoors and less time outdoors than children did in the past.

Scholars dedicated to studying the child–nature relationship have shown that children's experiences in nature are rapidly declining (Chawla, 2006b; Faber Taylor & Kuo, 2006; Gaster, 1991; Hofferth & Sandberg, 2000; Kellert, 2002; Louv, 2005; Pyle, 2002; Wells & Lekies, 2006) because children's daily lives are increasingly filled with structured and programmatic activities (Rosenfield & Wise, 2001) and because children and youth are devoting ever more time to playing and using video games, computers, and the Internet (Faber Taylor & Kuo, 2006; Louv, 2005). In fact, surveys by the Kaiser Family Foundation and the Centers for Disease Control have shown that a child is six times more likely to play a video game on a typical day than to ride a bike (Cauchon, 2005). Research also suggests that parental concerns about crime and safety prevent many children from playing outdoors and exploring nearby nature (Valentine & McKendrick, 1997). Thus, there is growing evidence that children and youth in the United States have become “de-natured” (Faber Taylor & Kuo, 2006; Louv, 2005, 2007).

Children in the United States are also currently experiencing an unprecedented set of health problems. These problems include increased levels of depression, cognitive disabilities, attention disorders, obesity, hypertension, and diabetes (Center for Health, Environment, and Justice, 2001; Centers for Disease Control, 2007; Louv, 2005). As noted above, these changes in children's health and behavior have led many environmental health scientists and environmental psychologists to ask whether the negative health trends children are experiencing are due, at least in part, to children's diminished contact with nature. Research demonstrates, for example, that there is a significant association between decreased outdoor activity, increased time indoors, and rising childhood obesity (Frumkin, 2005; Frumkin & Louv, 2007; Louv, 2005), which, in turn, is linked to serious and long-term physical health risks, including coronary heart disease, hypertension, Type 2 diabetes, stroke, sleep apnea, respiratory problems, and some cancers (Centers for Disease Control, 2007). Studies have also shown that the average American child spends more time watching television (1,023 hours per year) than in school (900 hours per year; Sharif & Sargent, 2006) and that the amount of “screen time” (computer, television, videogames) that children experience per week directly correlates with their measure of body fat (Louv, 2005). Federal and state policies have compounded this problem by making it harder for children to get outside during the school day (Louv, 2005). For example, the No Child Left Behind Act (NCLB) of 2001 has pressured schools to cancel or reduce recess to prepare for standardized tests and meet new school accountability goals (Louv, 2005; Sacks, 2005). With such dramatic increases in sedentary behavior among American children, it should not be surprising that 50% of school-age children and adolescents in the United States are overweight (Berk, 2005).

Although the long-term physical health impacts of children's inactivity and obesity can take decades to develop, an unprecedented number of children currently experience acute mental and cognitive disorders that may be tied directly to physical inactivity and lack of exposure to the natural world (Frumkin & Louv, 2007; Kellert, 2005; Louv, 2005; Petty et al., 2005). Childhood depression, for example, has become a serious mental health issue among children and youth in the United States, as demonstrated by the National Institute of Mental Health, which estimates that 2.5% of all children and 8.3% of all adolescents have clinical depression (Birhafer, Ryan & Williamson et. al 1996). Consistent with this finding, the rate at which American children were prescribed antidepressants doubled from 1998 to 2002,

showing that the use of antidepressant medications among American children is on the rise (Delate, Gelenberg, Simmons, & Motheral, 2004).¹

An even more pressing issue may be the proliferation of learning disabilities, hyperactive disorders, and concentration problems among today's children (Center for Health, Environment, and Justice, 2001). For instance, attention deficit hyperactivity disorder (ADHD) has become one of the most prevalent neurobehavioral disorders among children (Center for Health, Environment, and Justice, 2001). ADHD affects more than two million school-age children (Faber Taylor et al., 2001), and between 2000 and 2003, spending on ADHD medication for preschoolers increased by 369% (Louv, 2005).

The rising incidence of these cognitive and mental health disorders among American children is in part the result of a growing awareness of, and advanced screening for, such disorders by pediatricians (Louv, 2005). Nevertheless, scholars are beginning to point to children's diminished contact with nature as a possible explanation for these alarming health trends because of evidence that demonstrates the profound positive effect that nature can have on children's physical health and mental well-being (Faber Taylor, Kuo, & Sullivan, 2001, 2002; Faber Taylor, Wiley, Kuo, & Sullivan, 1998; Grahn, Martensson, Lindblad, Nilsson, & Ekman, 1997; Petty et al., 2005; Wells, 2000; Wells & Evans, 2003).

The positive effects of nature exposure include improved cognitive functioning (including increased concentration, greater attention capacities, and higher academic performance), better motor coordination, reduced stress levels, increased social interaction with adults and other children, and improved social skills. For example, Fjortoft (2001) examined the effect of different outdoor play settings on children's motor coordination in three kindergarten outdoor play settings in Telemark, Norway. After controlling for socioeconomic status and parental education level, motor fitness tests showed that children who used a forest as a play setting performed better in motor skills tests than children who used a standard playground (e.g., a playground with a sandpit, a swing, a seesaw, and a slide). Similarly, a study carried out by Grahn et al. (1997) found that in urban Sweden children attending day care facilities surrounded by natural areas, such as woodlands and orchards, had greater attention capacities and motor coordination skills than did children who attended day care centers surrounded by tall buildings. Finally, in a longitudinal study that examined the effects of green residential settings on minority and low-income children, Wells (2000) found that cognitive functioning with regard to attention capacities greatly improved when children moved to housing that had more nearby green spaces. Taken as whole, these studies suggest that regardless of race and socioeconomic status, natural settings proximate to the home and school environment can have profound effects on children's cognitive and motor functioning.

Recent research also suggests that even views of nature can affect children's cognitive capacities, in particular their ability to concentrate. A study involving low-income African American children from public housing projects in urban Chicago reported that children living in relatively "green" apartment buildings (those with views of trees and green space) exhibited superior attention capacities and impulse control than similar children living in nongreen apartments (Faber Taylor et al., 2002). These findings suggest that the restorative, or beneficial, effects of nature are not limited to children from middle- and upper-income

¹As one of the reviewers helpfully points out, children's increasing use of prescription drugs is likely due in part to the ability of the pharmaceutical industry to get doctors to prescribe these drugs and in part to our society's "increasing focus on individual, or psychologized, solutions to what would otherwise be considered social problems." Nevertheless, studies such as that done by the NIMH in 2008 demonstrate that childhood depression is a real and serious public health problem.

families and that “contact with nature may support attention functioning in a population of children who desperately need attention support” (Kuo & Faber Taylor, 2004, p. 1584).

Because nature exposure has been shown to increase concentration levels among children with normal attention spans, scholars have begun to ask whether nature exposure also increases concentration capacities among children with ADHD. Only two studies have examined this question, yet both have shown that being active in green spaces reduces the symptoms of chronic attention deficit that children experience due to ADHD (Faber Taylor et al., 2001; Kuo & Faber Taylor, 2004). The first of these studies focused on urban Midwestern children, ages 7 to 12, and compared children’s concentration levels after various activities, including play in green areas, play in built environments (such as playing basketball on an asphalt court), and play indoors (such as video games). This study found that children with symptoms of ADHD were better able to concentrate, complete tasks, and follow directions after playing in natural settings than they were after playing indoors or in built environments.

The second study was an Internet-based study that examined a similar set of questions but for a broader sample of youth (Kuo & Faber Taylor, 2004). This study asked parents to rate the effects of common after-school and weekend activities on their child’s ADHD symptoms (Kuo & Faber Taylor, 2004). Results showed that among this sample of families and children, outdoor activities in green, natural settings reduced children’s ADHD symptoms more than activities in other settings (Kuo & Faber Taylor, 2004). These findings held across household income levels, geographic areas of residence, and residence in communities of various sizes. Thus, “the benefits of exposure to relatively green settings seemed to hold despite what must have been wide variation in the specific green outdoor, built outdoor, and indoor settings available to children in these different subpopulations” (Kuo & Faber Taylor, 2004, p. 1584).

In addition to improving cognitive functioning and motor coordination, access to nature appears to positively influence children’s academic performance (American Institutes for Research, 2005; Rivkin, 1997; White, 2004). For example, Lieberman and Hoody (1998) compared student academic performance across 40 different schools in the United S and found that students in schools with environment-based education performed better on standardized academic tests and earned higher grade point averages than did students in schools with indoor curricula.² Consistent with Lieberman and Hoody (1998), the National Environmental Education Training Foundation (2005) examined the effects of environment education on student’s academic performance across 11 different schools representing diverse student populations; urban, rural, and suburban settings; and a range of socioeconomic backgrounds. The study found that compared with traditional educational approaches, environmental-based education improves academic performance across the curriculum. In fact, students in schools with environment-based education had higher test scores in reading, math, science, social studies, and writing than did students in traditional public schools (National Environmental Education and Training Foundation, 2000, 2005). Finally, schools that use local natural areas in their curricula have been shown to encourage cooperative learning and civic responsibility among students across diverse geographical settings and socioeconomic groups (National Environmental Education and Training Foundation, 2005; Rydberg, 2007). Although more research in this area is needed, especially

²It is possible, of course, that middle-class children are more likely than low-income children to both perform well on standardized tests *and* attend schools with environment-based education programs, suggesting that the relationship between standardized test scores and environment-based education programs may be spurious. Nevertheless, this is not likely to be the case. As this section demonstrates, numerous studies find that regardless of race and socioeconomic status, a strong relationship exists between youth exposure to nature and improved cognitive functioning, reduced stress levels, increased interaction with adults, and improved social skills, all of which should improve children and youth’s academic performance.

research that examines the effects of nature exposure and environmental education across different racial, ethnic, and income groups, the evidence indicates that nature- and environment-based education enhances youth academic performance, which could have profound implications for schools and youth across the nation.

In addition to increasing cognitive functioning and improving academic performance, exposure to nature has been shown to mitigate childhood stress, even among rural children. For example, using standardized scales to measure stress in the lives of 337 rural children, Wells and Evans (2003) found that

life's stressful events appear not to cause as much psychological distress in children who live in high-nature conditions compared with children who live in low-nature conditions...and the protective impact of nearby nature is strongest for the most vulnerable children, those experiencing the highest levels of stressful life events. (p. 322)

The authors go on to argue that children's access to nature is particularly important as a buffer to childhood stress, because if left unchecked, cumulative stress can lead to a host of long-term mental and physical health problems (Wells & Evans, 2003).

Green spaces have also been shown to foster social interaction and thereby promote social trust and community perceptions of safety (Coley, Sullivan, & Kuo, 1997; Kuo, Bacaicoa, & Sullivan, 1998; Kuo, Sullivan, Coley, & Brunson, 1998). For example, a series of studies completed in and around public housing projects in one of Chicago's poorest inner-city neighborhoods have produced important findings regarding the social benefits of nearby green spaces, particularly among African American families. One of the first studies completed in this area (Coley et al., 1997) found that nearby outdoor spaces with trees were used more frequently by both children and adults than were barren outdoor spaces, leading the authors to conclude that incorporating natural landscaping around inner-city buildings encourages opportunities for social interaction. Another study in this area (Faber Taylor et al., 1998) examined the behavior of poor inner-city African American children in outdoor spaces around 64 housing projects. Controlling for environmental features such as the architecture of the housing projects, the vacancy rates of nearby buildings, and distances from high-traffic streets, the study found that children had greater access to adults and were more likely to play with other children in green spaces compared with relatively barren spaces. The authors point out that outdoor play and access to adults are both essential for children's social and cognitive development. Finally, using photo simulations of various neighborhood outdoor spaces, Kuo et al. (1998) found that tree density and grass maintenance increased perceptions of safety among African American residents living in low-income Chicago public housing.

Poor and minority residents living in Chicago public housing units with barren surroundings also reported observing more aggression and violence than did similar residents who lived in housing projects with greener surroundings (Kuo & Sullivan, 2001a). Because of these results, Kuo and Sullivan (2001b) decided to examine the relationship between green spaces and crime by comparing police crime reports and vegetation levels surrounding these housing projects. They found that fewer property and violent crimes were reported in areas surrounding "green" apartment buildings than in areas surrounding "barren" apartment buildings. Moreover, levels of "greenness" around a building remained a significant negative predictor of property crime, violent crime, and total crime even after controlling for the number of apartments per building, building vacancy rates, and building height.

Overall, these studies suggest that green public settings encourage social interaction among both youth and adults, which may increase social trust, decrease crime, and increase perceptions of community safety (Kuo et al., 1998; Raffan, 2000).

Studies have also investigated whether playing in nature improves children's social skills by developing their language and communication abilities and encouraging positive relationships (Pyle, 2002). This research indicates that playing in natural environments encourages social interaction between children (Bixler, Floyd, & Hammitt, 2002; Moore, 1986). It also indicates that children who play in nature have more positive feelings about each other (Moore, 1996). For instance, Moore and Wong (1997) found that transforming an elementary schoolyard in Berkeley, California, from an asphalt playground to a natural area with woodland, gardens, and ponds resulted in children having more positive relationships with each other. Researchers have also found that playing in nature reduces, and in some cases eliminates, bullying and violent behavior between youth (Coffey, 2001, Malone & Tranter, 2003; Moore & Cosco, 2000). Finally, researchers have observed that children's play in natural environments is more diverse, imaginative, and creative than children's play in other settings (Cobb, 1977; Faber Taylor et al., 1998) and that creative play encourages language development and social and collaborative skills (Fjortoft & Sageie, 2000; Moore & Wong, 1997).

In sum, a diverse number of studies indicate that contact with nature is important for children's cognitive, emotional, social, and educational development regardless of children's race or socioeconomic status. However, more evidence is needed to fully document the causal link between exposure to nature and healthy childhood development (Faber Taylor & Kuo, 2006). For example, researchers still need to disentangle the various factors that are likely to contribute to health disparities among youth to better determine what role access to nature plays in producing these health disparities. Nevertheless, current research strongly suggests that, "until proven otherwise, we can continue to assume, [that] just as they need good nutrition and adequate sleep, children may very well need contact with nature (Faber Taylor & Kuo, 2006, p. 136).

Experiences in Nature and Environmental Concern

Although it is clear that children benefit both physically and mentally from being exposed to nature, childhood exposure to nature may also benefit the natural world by increasing environmental concern among children, youth, and adults. Research has shown, for example, that positive and frequent experiences in nature during childhood influence environmental career choices and environmental concern among adults regardless of their cultural background or racial and socioeconomic status (Chawla, 2006a; Wells & Lekies, 2006). Research on environmental education programs also demonstrates that youth with more experience in nature exhibit stronger personal relationships to nature and are more likely to express the need to protect nature compared with youth with less outdoor experience. Taken together, this research shows that early childhood experiences in nature can influence the development of lifelong environmental concern.

Although such studies demonstrate that direct experiences of nature shape environmental attitudes, most research in this area indicates that onetime experiences are not as influential as daily exposure to nature and green spaces (Gillet, Thomas, Skok, & McLaughlin, 1991; Newhouse, 1990). Indeed, research shows that a lack of regular positive experiences in nature is associated with the development of fear, discomfort, and dislike of the environment (Bixler, Carlisle, Hammitt, & Floyd, 1994). For instance, during a field trip to a wildland area outside of Chicago, urban youth reported a wide variety of fears and negative emotions, including a fear of snakes and feelings of disgust in relation to natural objects (Bixler et al., 1994); and in a study of inner-city Detroit, poor African American youth associated nature

with dangerous people, suggesting that they perceived natural settings as being threatening and unsafe (Wals, 1994). Finally, a study of Latino youth's perceptions of wildlife in Kansas City found that a lack of positive experiences with wildlife and negative messages about wildlife promoted feelings of disconnect from and dislike of nature and wildlife (Van Velsor & Nilon, 2006). Although the causes of children's discomfort in and aversion to nature may stem from multiple factors (e.g., unfamiliarity with nature, safety issues, fear), these negative emotions likely shape youths' lifelong perceptions of the natural world.

Thus, this body of evidence suggests that growing up in highly urbanized areas with few green spaces is likely to negatively affect the way youth perceive, know, and come to appreciate the natural environment (Branch, 2000). Moreover, scholars dedicated to understanding the child-nature relationship argue that the development of ecophobia, or fear of the natural world, can further isolate youth from nature and potentially influence future decisions they make regarding environmental protection (Louv, 2005; Pyle, 1993; (Sobel, 1993) Sobel, 1999). As a result, limited childhood exposure to nature is likely to influence the degree to which youth support and participate in efforts to protect the environment.

In sum, the environmental health, environmental education, and environmental psychology literatures suggest that access and exposure to, and play in, nature can have profound positive effects on children's emotional, physical, and psychological development and well-being. Moreover, positive experiences in nature are likely to affect children's future relationships with the natural world and instill a greater sense of environmental concern for generations to come.

Youth Access to Nature and Environmental Inequality

Very little research specifically examines environmental inequalities surrounding youth access to nature and green spaces. Nevertheless, empirical evidence suggests that youth's experiences in and access to nature and green spaces are likely to vary according to race, ethnicity, and socioeconomic status (Frumkin, 2005; Hart, 1979; Hood, 2005; Kahn & Friedman, 1995; Platt, 2008; Rideout, 2000; Wolch, Wilson, & Fehrenback, 2002). For example, several studies indicate that youth from low-income and minority families have relatively limited access to greenways, sports fields, and trails that support and encourage physical activity (Frumkin, 2005; Hood, 2005; Lindsey, Maraj, & Kuan, 2001; Sallis, Zakarian, Hovell, & Hofstetter, 1996); and a study completed in Los Angeles shows that poorer neighborhoods as well as areas dominated by Latinos, African Americans, and Asian-Pacific Islanders have significantly lower levels of access to park resources than areas dominated by Whites (Wolch et al., 2002). Such evidence is not surprising because of the fact poor people and people of color disproportionately live in low-income areas and substandard housing, which are less likely to be proximate to green and natural spaces (Frumkin, 2005; Kohlhuber et al., 2006).

Research has also shown that Latinos and African Americans are less likely than Anglo Americans to use outdoor recreation areas, local parks, and nature centers (California State Parks, 2005; Dwyer, 1993; Elmendorf, Willits, & Sasidharan, 2005; Rodriguez & Roberts, 2002). Barriers to use and participation appear to be complex and interrelated, including unfamiliarity with natural areas, cultural preferences that affect youth participation in green space activities, racial discrimination, language differences between youth and those who manage and normally use local green spaces, lack of available transportation, and program expense (Elmendorf et al., 2005; Frumkin, 2005). For instance, Hong and Anderson (2006) found that some of the biggest cultural barriers to attending local nature centers among Latinos were the non-Spanish speaking staff and the perception that nature centers are places for "White people with money." These findings are consistent with those of other studies

that have shown that limited exposure to green spaces among low-income and minority youth may result from a lack of cultural diversity among environmental education participants, staff, and programs that may make minority and low-income youth and families feel unwelcome (Rideout, 2000; Wals, 1994).

In sum, prior research suggests that minority and low-income youth are less likely than White and higher-income youth to have adequate access to and positive experiences in green spaces and nature. Nevertheless, very little research has been done to determine whether this is, in fact, true. As a result, researchers know more about the developmental and health issues associated with youth's underexposure to nature than they do about racial, ethnic, and socioeconomic differences in youth's exposure to nature. As we argue in the next section, this is an important gap in the literature that environmental inequality researchers should seek to fill.

New Directions in Environmental Inequality Research

The literature reviewed in this article clearly demonstrates that youth access to green spaces and nature has important implications for children's mental, physical, emotional, and social development and that youth are more susceptible than adults to the negative health effects associated with residential proximity and exposure to pollution. Given the important public health implications of this research, it is crucial that environmental inequality researchers determine whether minority and low-income youth are more likely than other youth to live in polluted neighborhoods and less likely to have regular access to green spaces and nature.

Although existing research clearly suggests that this is the case, only a limited number of studies have actually investigated these questions, and of those that have, only a few are situated within the environmental inequality literature. Moreover, even fewer studies have examined why youth-based environmental inequality exists or is likely to exist. This represents an important gap in the literature that must be filled if we are to fully understand both environmental inequality in the United States and class- and race-based disparities in health and education among this nation's youth. Thus, in the remainder of this section, we discuss several avenues of research that if undertaken will significantly increase our knowledge of youth-based environmental inequality.

However, before proceeding, it is important to note that when we discuss possible studies that researchers can undertake to determine *why* youth-based environmental inequality exists, we focus solely on studies that would investigate why minority and low-income youth are less likely than other youth to have regular access to green spaces and nature. We do this not because we think unequal youth access to pollution is unimportant, but because several explanations already exist for why minorities and low-income individuals are disproportionately exposed to pollution. In addition, discussing these explanations would increase the length of the manuscript considerably.

Determining Whether Youth-Based Environmental Inequality Exists

Environmental inequality researchers are in a unique position to determine whether youth-based environmental inequality exists. Not only do they have extensive experience comparing the demographic and environmental characteristics of neighborhoods, they have also collected much of the data necessary to determine whether minority and low-income youth experience environmental inequality. For example, environmental inequality researchers have collected environmental hazard data for neighborhoods throughout the continental United States and can easily merge these data with individual-, family-, and neighborhood-level data on youth and family structure, allowing them to determine whether

youth-based environmental inequality is a serious social and public health problem in the United States.

Few environmental inequality researchers have combined individual- or family-level demographic data with neighborhood-level environmental hazard data. Thus, merging these data would not only provide far greater insight into youth-based environmental inequality than would be possible if researchers were to rely solely on neighborhood-level demographic data, it would also represent an important methodological advance in environmental inequality research.

Environmental inequality researchers should also merge data on the location of parks and green spaces with previously collected demographic and environmental hazard data to compare, within a single study, differential youth access to green spaces and differential youth exposure to environmental hazards. It is important to note, however, that just as measuring proximity and exposure to environmental hazards is methodologically complex (Downey, 2006a, 2006b), so too is measuring proximity and access to green spaces and natural areas.

For example, this article's lead author is currently conducting research with 50 Latino and Caucasian children (ages 10–12) from various socioeconomic backgrounds who live in the Denver, Colorado, metropolitan area (Strife, 2008). Although her findings are still in the preliminary stage, it appears that among the study's participants, middle-class White children have more frequent experiences than low-income Hispanic children in "far-away" and "pristine" natural settings such as national parks, summer camps, and mountain resorts. The study's low-income Hispanic respondents rarely get to experience these far-away and pristine natural settings due to economic constraints and limited transportation options that make travel and summer camp prohibitively costly.

Moreover, although it appears that poor Hispanic children have daily nature experiences in community green spaces and parks, a majority of these children expressed fear of these spaces because of gang activity, stranger danger, and busy traffic (Strife, 2008). These barriers not only restrict this group's opportunities to play freely in nearby nature spaces but also affect their overall desire to want to play outside because of common fears of getting shot, kidnapped, sexually assaulted, and hit by cars (Strife, 2008).

Similar results were found in a study of low-income and minority children in Milwaukee, Wisconsin (Platt, 2008), most of whom were afraid of local green spaces because of concerns of being kidnapped by strangers, "getting jumped" by gangs, or being hit by dangerous drivers. Thus, the mere presence of parks may not be a true measure of access to green spaces in many urban communities because of fear of gang violence and crime (Lopez & Hynes, 2006). Taken together, these findings suggest that youth access to nature may be less about proximity to and availability of local green spaces and more about access to *safe* outdoor spaces, community trust, and the ability to travel to far-away and pristine natural settings.

Thus, using quantitative indicators such as "distance to the nearest park" to measure youth access to green spaces and nature is highly problematic. As a result, it seems likely that environmental inequality researchers will have to rely more heavily on qualitative methodological approaches, such as ethnographic and participatory action field methods, that will allow them to gain greater insight into both the perceived and real environmental risks and experiences youth encounter. Such methods will provide researchers with better information with which to compare the environmental risks and experiences of youth from different racial, ethnic, and socioeconomic backgrounds and will allow researchers to

examine how the meanings that youth give to their environments vary according to race and socioeconomic status.

Finally, information gathered from specific populations of youth through interviews and ethnographic observation should be combined with quantitative data that directly measure these youths' exposure to environmental pollutants (exposure data can be obtained by monitoring the air and water quality of the neighborhoods, schools, and green spaces that these youth inhabit). Merging these data will allow environmental inequality researchers to more accurately measure youth-based environmental inequality and will help researchers determine whether access to green spaces is denied to certain groups of youth because of potential risks that exist within these spaces (risks include gang activity, crime, and even pollution).

Why Do Youth-Based Inequalities Exist?

In addition to determining whether youth-based environmental inequality exists, future environmental inequality research should more directly address why such disparities exist. What are the larger institutional, structural, and cultural forces that explain why some groups of children are denied equal access to nature and nature experiences? And more broadly, how do these institutional, structural, and cultural forces undermine children's mental health, physical well-being, and academic success?

For example, as previously mentioned, the NCLB Act has indirectly caused a sharp decline in both physical education and recess in schools across the United States, with schools that have the highest poverty concentrations experiencing the steepest declines in recess (Parsad & Lewis, 2006). Childhood development specialists, child psychologists, and educational experts agree that just a half-hour of recess, especially in green spaces, bolsters test scores, improves academic performance, and reduces the chance of obesity among children (Sacks, 2005). Therefore, it seems likely that the NCLB undermines the academic achievement and physical health of minority and low-income students in many communities across the United States.

Because it is likely that other educational and institutional policies operate in similar ways to undermine the academic achievements and health of minority and low-income children, it is important that environmental inequality researchers determine which policies, if any, disproportionately affect these youths' outdoor activity and access to green spaces. It is also important to investigate whether other factors that explain poor academic achievement among minority and low-income youth are associated with lack of nature exposure. Addressing these issues will help researchers to clarify the relationship between access to nature and specific educational outcomes and may result in the development of alternative explanations for the well-documented decline in children's academic achievement and overall well-being.

Another explanation for children's increased time indoors and declining health is that poorly planned urban development and suburban sprawl degrade green spaces, perpetuate dependency on cars for transit, and make it more difficult for youth to walk to local parks and green spaces. For instance, poorly designed street patterns, streets without sidewalks, lack of pedestrian walkways, and fragmented subdivisions that can only be reached by major roadways are all examples of poor urban and suburban design intended for cars, not children at play (Jackson & Tester, 2008). As a result, fear of traffic is one of the central reasons that parents give for not allowing their children to play outdoors, further discouraging nature exploration among children in urban and suburban locations throughout the United States (Valentine & McKendrick, 1997). Moreover, increased car use not only keeps children

indoors because of parental safety concerns, it also increases a child's risk of becoming overweight (Frumkin, 2005; Jackson & Tester, 2008).

These explanations for why children are more likely to play indoors than outdoors suggest that environmental inequality researchers should investigate whether urban and suburban design disproportionately affect minority and socioeconomically disadvantaged children. Although this is likely to be the case, it is also possible that such research will reveal that fewer inequities exist between suburban and urban children than we might otherwise expect, as both groups confront design-related obstacles that discourage free play in green spaces and nature.

Future environmental inequality research should also ask whether factors such as gentrification, transit infrastructure, the privatization of public space and residential segregation play an important role in reducing minority youths' access and exposure to green spaces and nature. For example, is less public money spent on creating and maintaining green spaces and natural settings in segregated minority communities than in other communities? Do residential segregation and the privatization of public space physically separate minority youth from green spaces and nature (Downey, 2007; Smith, 2007)? Do gentrification and residential segregation interact with other factors to increase neighborhood poverty levels (Massey & Denton 1993), making it more difficult for families living in segregated neighborhoods to travel to pristine natural settings? And does residential segregation place minority youth in schools that are less likely to expose students to safe and nurturing natural environments?

In addition to answering these questions, environmental inequality researchers should also ask whether cultural preferences for, and perceptions of, green spaces and nature vary according to race, ethnicity, and income, differentially influencing minority, White, low-income, and middle-class youths' desire to experience nature. Moreover, does the depiction and possible devaluation of nature by the mainstream media influence these preferences and perceptions? And if so, does this affect different groups of youth differently? For example, are different groups of youth exposed to different media messages about the environment? Or, do different groups of youth interpret the same media messages in different ways because of their membership in different subcultures?

Finally, environmental inequality researchers should determine whether housing agency policies and decisions about where to locate low-income housing diminish minority and low-income youth's contact with green spaces and nature. Such research could investigate whether declines in public agency funding since the 1980s have resulted in the deterioration of green spaces in and near low-income housing and whether other public policies, such as federal and state welfare policy and local policing policies, interact with housing agency policy to diminish minority and low-income youths' access to green spaces and nature.

Conclusion

As the preceding discussion makes clear, determining whether and why youth-based environmental inequality exists will not be easy. Not only are the methodological issues associated with making this determination quite complex, it is also likely that a myriad factors interact to determine whether some groups of youth are more likely than others to live in polluted neighborhoods and whether some groups of youth have little or no exposure to green spaces and nature.

Nevertheless, if environmental inequality researchers want to fully understand environmental inequality in the United States, and if they want to generate knowledge about class- and race-based disparities in health and education among this nation's youth, they

must determine whether youth-based environmental inequality exists, and if so, why it exists. Thus, we strongly encourage environmental inequality researchers to expand their research efforts and their definitions of environmental inequality to include unequal youth access to environmental amenities such as nature, green spaces, and parks and unequal youth exposure to toxic pollutants.

In calling on environmental inequality researchers to expand their definitions and research to include youth and youth access to green spaces and nature, we are not arguing that environmental inequality researchers should curtail the kind of research they are already doing. Determining whether and why poor people and minorities of all age groups are disproportionately exposed to environmental pollutants has important public health ramifications that cannot be ignored, and we believe that it would be a great mistake to do so. Nevertheless, we also believe that differential youth access to the natural world and differential youth exposure to environmental hazards are critically important dimensions of environmental inequality that must be studied if researchers are to develop a complete, accurate, and nuanced understanding of environmental inequality in the United States.

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Biographies

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