

Outdoor Time, Screen Time, and Connection to Nature: Troubling Trends Among Rural Youth?

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Abstract

Evidence suggests that contemporary children are spending less time outdoors than their predecessors. Concurrent reports also highlight the rise of electronic media use in the lives of youth. We explored relationships between self-reported outdoor time, screen time, and connection to nature in a sample of sixth- to eighth-grade students across rural South Carolina ($N = 543$). We found that most youth spent time outdoors, but they spent more time with electronic media. The outdoor versus screen time discrepancy was particularly pronounced for girls, African Americans, and eighth graders. Connection to nature, linked to outdoor time, was highest among boys, White students, and sixth graders. Our study contributes to growing evidence highlighting the negative influence of escalating screen time on outdoor time and connection to nature during adolescence. Programs designed to address these troubling trends could focus on two groups at particularly high risk: girls and youth of color.

Keywords

children, nature, media use, outdoor recreation, race/ethnicity

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Introduction

A growing body of evidence suggests contemporary youth are spending less time outdoors than their predecessors (Hofferth, 2009; Kellert, 2005; Louv, 2005; Pergams & Zaradic, 2008). Some researchers have even noted that the conceptualization of youth play has shifted from a primarily outdoor to a predominantly indoor activity (Karsten, 2005; Karsten & van Vliet, 2006; Louv, 2005). Recent findings suggest that, despite interest in nature and conservation across the United States, this general decline in youth time outdoors—particularly time in nature—continues today (Kellert et al., 2017; Larson, Green, & Cordell, 2011).

The implications of this shift on positive youth outcomes are profound (Kahn & Kellert, 2002; Louv, 2005). Some scholars suggest that humans are evolutionarily predisposed to benefit from contact with nature—a concept often described as “biophilia” (Kellert & Wilson, 1993). Reducing or removing that connection to nature (CTN) could be detrimental in a number of ways. Participation in various types of outdoor activities can help strengthen children’s social relationships (Dowdell, Gray, & Malone, 2011; Ginsburg, 2007), mental health (Burdette & Whitaker, 2005; Taylor & Kuo, 2006, 2011), physical health (Maller, Townsend, Pryor, Brown, & St Leger, 2006), creativity (Atchley, Strayer, & Atchley, 2012), and conservation orientations (Chawla, 2007; Larson, Whiting, & Green, 2011). An individual’s outdoor time—particularly during childhood—can also foster CTN, which yields a range of other benefits (Braun & Dierkes, 2017; Schultz & Tabanico, 2007). Mayer and Frantz (2004) defined CTN as an individual’s “affective, experiential connection to nature” (p. 504). Studies suggest that nature “connectedness” or “relatedness” contributes to positive emotions, happiness, and subjective well-being (Capaldi, Passmore, Nisbet, Zelenski, & Dopko, 2015; Cervinka, Roderer, & Hefler, 2012; Clayton & Opatow, 2003; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Nisbet, Zelenski, & Murphy, 2011; Zelenski & Nisbet, 2014). Furthermore, CTN is relatively stable over time (Braun & Dierkes, 2017; Ernst & Theimer, 2011; Wells & Lekies, 2006); it is therefore critical to identity factors that influence youth time outdoors and CTN (Larson & Verma, 1999; Lovelock, Walters, Jellum, & Thompson-Carr, 2016).

Various explanations have emerged to explain downward trends in youth time outdoors (Clements, 2004). These potential factors include increased academic pressures (Dowdell et al., 2011), growing involvement in structured activities (Hofferth, 2009; Skar & Krogh, 2009), and parental concerns about the safety of outdoor environments (Carver, Timperio, & Crawford, 2008; Islam, Moore, & Cosco, 2016; Loebach & Gilliland, 2014; Weir,

Etelson, & Brand, 2006). One potential barrier, in particular, has received substantial attention: the rapid rise and influence of electronic media and technology (e.g., interaction with television [TV], video games, Internet, smartphones) in the lives of youth. Often referred to as “videophilia” (Zaradic & Pergams, 2007), this phenomenon has been identified as a key factor linked to declining nature-based outdoor time for youth (Anderson, Economos, & Must, 2008; Kellert et al., 2017; Larson, Green, & Cordell, 2011). By the year 2000, for instance, youth in the United Kingdom were more likely to successfully identify cartoon characters than local wildlife species (Balmford, Clegg, Coulson, & Taylor, 2002). Since then, the expanding influence of electronic media time (hereafter, “screen time”) on youth is even more remarkable (Roberts & Foehr, 2008; Vandewater et al., 2007). In their 2009 national study of youth ages 8 to 18, Rideout, Foehr, and Roberts (2010) found that the average American child spends over 7 hr per day interacting with various types of electronic media, an increase of more than an hour when compared with a 2004 sample. In a more recent study, average daily screen time usage reported by youth ages 13 to 18 was up to 9 hr (Rideout, 2015). Fueled by an explosion of mobile media devices, those numbers may be even higher today (Nielsen Company, 2017). This escalating use of electronic media has also been linked to heightened risk of physical and psychological health problems (Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016; Sisson, Broyles, Baker, & Katzmarzyk, 2010; Zaradic & Pergams, 2007).

Decreasing outdoor time, associated declines in CTN, increasing screen time, and the relationships among these activities may differ across youth. First, these trends may differ by gender. Research has found that—among both youth and adults—males face fewer barriers and engage more often in outdoor recreation than do females (Culp, 1998; Johnson, Bowker, & Cordell, 2001; Metcalf, Graefe, Trauntvein, & Burns, 2015; Raymore, Godbey, & Crawford, 1994). However, though they did not assess broader outdoor time, Kellert et al. (2017) found no discernible differences among boys’ and girls’ nature-based recreation. While Kellert et al. (2017) also observed minimal gender differences in youth’s media use, Rideout (2015) found that, among adolescents, males and females differ in media preferences and behaviors. Although research suggests that adult women often hold stronger proenvironmental attitudes and values than do men (Milfont & Duckitt, 2004; Zelezny, Chua, & Aldrich, 2000), studies focused on youth perspectives have revealed few gender differences on metrics related to ecological affinity and awareness (Larson, Castleberry, & Green, 2010). These mixed results warrant additional research to better understand associations between gender, outdoor time, screen time, and CTN among youth.

Second, these trends may disproportionately affect racial and ethnic minorities. Racial and ethnic minority youth (and adults) typically spend less time in natural outdoor settings and face more constraints to nature-based recreation than their White counterparts (Byrne & Wolch, 2009; Finney, 2014; Floyd, Shinew, McGuire, & Noe, 1994; Johnson et al., 2001; Kellert et al., 2017; Larson, Green, & Cordell, 2011; Parker & Green, 2016; Shores, Scott, & Floyd, 2007). However, these same populations of color also report general support for public lands and the environment (Jones, 1998; Schurmann, 2016). Accessibility of safe outdoor spaces is often a problem: Minority children from low-income communities typically have fewer opportunities to access natural areas and, therefore, fewer opportunities to enjoy the benefits of time in nature (Bullard, 1993; Fisman, 2005; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Holt et al., 2009). Minority youth—particularly African Americans—are also significantly more likely than White youth to consume electronic media (Nielsen Company, 2017; Rideout et al., 2010).

Third, disengagement with nature and engagement with electronic media may increase as children progress into adolescence. Outdoor time and metrics associated with CTN (e.g., eco-affinity) appear to decline precipitously in early adolescence (ages 11-14) when compared with the childhood years (Braun & Dierkes, 2017; Kellert et al., 2017; Larson, Green, & Castleberry, 2010; Larson, Green, & Cordell, 2011). Screen time often peaks during that same stage: the middle school years (Rideout et al., 2010). More research is needed to understand the complex factors associated with outdoor time during the transitions from early childhood through adolescence and into early adulthood (Lovelock et al., 2016).

Finally, few studies of youth outdoor time and CTN have focused on rural contexts. For example, although research has demonstrated positive relationships between urban green space and children's physical activity (Boone-Heinonen, Casanova, Richardson, & Gordon-Larsen, 2010; Roemmich et al., 2006), research regarding the physically active outdoor time of youth in rural areas is lacking (Larson, Whiting, Green, & Bowker, 2015; May, 2011; Michimi & Wimberly, 2012). Tests of the assumption that individuals raised in rural settings have greater access to natural resources than do urban dwellers, thereby resulting in higher levels of CTN (Hinds & Sparks, 2008), are also inconclusive. For instance, some studies explain how rural youth's experiences and conceptualizations of nature may differ from those of children from cities, especially when the "countryside" becomes part of their lifestyle and identity (King & Church, 2013). Other studies reveal few differences in CTN between children in urban and rural settings, perhaps due the greater mobility of urban youth (Loebach & Gilliland, 2014).

As this overview suggests, much remains unknown about the relationships between youth outdoor time, screen time, and CTN across demographically diverse populations of children—particularly those residing in rural areas. Therefore, the purpose of this study was to (a) identify the amount of time rural middle school students spend outdoors in nature (outdoor time) versus with electronic media (screen time), including differences by gender, race/ethnicity, and age/grade; (b) describe rural middle school students' connectedness to nature, including differences by gender, race/ethnicity, and age/grade; and (c) examine associations between outdoor time, screen time, and connectedness to nature.

Method

Participants

From 2015 to 2016, we surveyed middle school students in rural counties across the state of South Carolina as part of a larger study on positive youth development. We systematically selected middle schools and out-of-school program sites that, based on U.S. census data, were in low-income regions with racially and ethnically diverse populations. A total of 700 students at 10 different sites completed the questionnaire, with the number of surveys completed at each site ranging from 14 to 132 and response rates ranging from 13% to 100% (overall response rate = 38%). To ensure that all students in the sample were indeed middle school-age youth from rural areas, we filtered out any respondents not in Grades 6 to 8 and those from school districts and program sites coded as “city” or “suburb.” This resulted in an effective sample size of 543.

Procedure

The survey instrument was completed in either paper format or through an online Qualtrics survey (Qualtrics, Provo, UT) with trained study staff on hand. In both modalities, youth completed the survey in a group setting with peers present and submitted the survey to the study staff or through the online portal once they were finished. We attempted to limit the potential for response bias using several empirically supported strategies (Bowling, 2005). First, the study staff received training on the protection of human subjects; they were also former teachers familiar with youth settings. Second, the study staff provided assurances of anonymity to participants. Finally, appropriate classroom management techniques were implemented during the administration of the surveys so that youth completed the surveys on their own; talking among youth during survey administration was not permitted. The survey

instrument measured many different aspects associated with youth development as part of the larger study, including the two that are the focus of this article: time spent outdoors in nature (outdoor time) and time spent engaged in media-based activities (screen time).

Measuring Outdoor Time and Screen Time

We measured youth-reported outdoor time and screen time using two items. The first item focused on nature-based outdoor time asked youth, "In the past week, including Saturday and Sunday, about how many *hours per day* did you spend *outdoors in nature* (in a park, a forest, a backyard or school playground with trees, or similar place)?" The second item focused on media use (i.e., screen time) asked youth, "In the past week, including Saturday and Sunday, about how many *hours per day* did you spend watching television, playing computer games, or using a computer/smartphone to go online each day?" Both questions (screen time and outdoor time) incorporated time spent engaged in each type of activity during school and outside of the school setting (i.e., during leisure time), and youth were encouraged to provide their best estimate of average time use across both weekdays and weekend days. Response options for both items included the following categories, with assigned values for data analysis based on the midpoint of the range for each response option: *none* (0 hr), *less than 0.5 hr per day* (0.25 hr), *between 0.5 and 1 hr per day* (0.75 hr), *between 1 and 2 hr per day* (1.5 hr), *between 2 and 3 hr per day* (2.5 hr), *between 3 and 4 hr per day* (3.5 hr), *between 4 and 5 hr per day* (4.5 hr), *more than 5 hr per day* (5.5 hr).

Although responses to this single-item self-reported metric may be affected by recall bias or inaccurate characterization of discretionary time, this data collection strategy has been effectively employed and interpreted in a variety of other national-level studies (Larson, Green, & Cordell, 2011; Outdoor Foundation, 2018; United States Fish & Wildlife Service, 2012). Researchers attempted to clarify the broad definitions of both "outdoor time" and "screen time" in the context of this study, but preconceived notions of what both meant may have influenced responses. To address this issue, each question prompt provided a list of possible nature-based outdoor activity settings and electronic media (developed through pilot testing) that helped to minimize confusion associated with potentially different interpretations.

Measuring CTN

Attempts to develop a comprehensive measure of nature connection have often struggled to separate cognitive (e.g., interest in nature) and affective

(e.g., emotional affinity for nature) components (Ernst & Theimer, 2011). To bridge this gap, we measured youth's CTN by employing adapted versions of two measures originally designed for adults that have been tested and validated in a number of previous studies.

The *Nature Relatedness* (NR) scale, created by Nisbet, Zelenski, and Murphy (2009), uses affective and experiential dimensions of the human–nature relationship to focus on an individual's sense of oneness with the natural world and a sense of equality between oneself and nature. The full 21-item version of this scale focuses on several constructs, but a shorter seven-item version of the NR scale that focuses on NR-experience (physical familiarity and comfort with the natural world) and NR-self (personal connection to and internalized identification with nature) may be preferable for use with younger audiences (E. K. Nisbet, personal communication, October 2014). The shorter scale displays a similar pattern of correlations with subjective well-being and environmental variables as the full 21-item scale (Zelenski & Nisbet, 2014). We used four items to measure NR-experience (e.g., My favorite places are outside in nature, I spend time outdoors whenever I can) and three items to measure NR-self (e.g., I feel very connected to all living things and the Earth, I think about how what I do affects the Earth), both measured from 1 = *strongly disagree* to 5 = *strongly agree*. Principal axis factor analysis with promax rotation supported the discriminant validity of this two-factor solution (Table 1), though the factor correlation was high ($r = .631, p < .001$).

The *Inclusion of Nature in Self* (INS) scale was created by Schultz (2001) and adapted from Aron et al. (1992). The INS is a graphical, single-item metric that measures the perceived relationship or interaction between the self and nature (Figure 1). It provides a parsimonious and straightforward measurement approach due to its graphical one-item design. Despite its simplicity, this scale is correlated with other measures of nature connectedness, commitment, and identity (Lieflander, Frohlich, Bogner, & Schultz, 2013). The INS test–retest correlations have also provided very high reliabilities between measurement times with a retest given 1 or 4 weeks after the initial test (Schultz et al., 2004). We converted student responses on the INS scale to a single integer score ranging from 1 = *no connection* to 5 = *complete connection*.

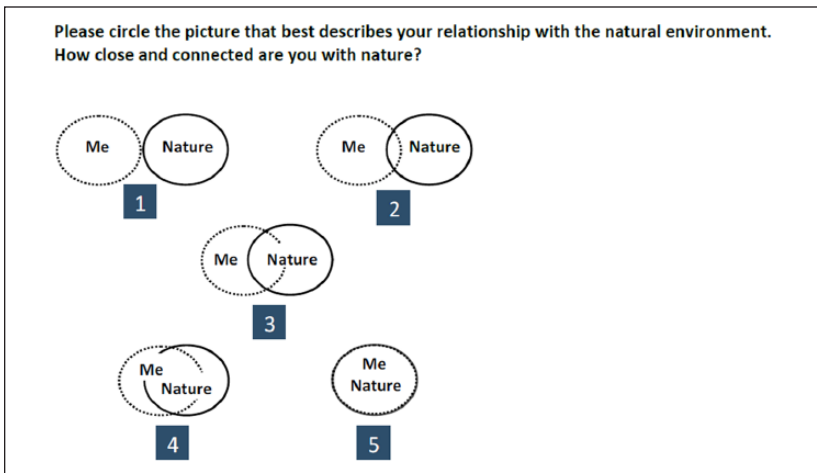
Data Analysis

Prior to analysis, the different CTN measures were aggregated into a single CTN index by summing the scores of both NR subscales and the INS scale. This was done due to high correlations among all three scales ($r > .585, p < .001$) and principal axis factor analysis with all variables showing that one

Table 1. Principal Axis Factor Analysis With Promax Rotation Depicting Two-factor Structure of Nature Relatedness Items ($N = 543$).

Factor (with items)	M	SD	Factor loadings			
			Pattern matrix		Structure matrix	
			A	B	A	B
A. Nature-relatedness (NR)—Experience (3 items, Cronbach's $\alpha = .837$)	3.93	1.01				
I enjoy being outside in nature	4.13	1.04	.950	-.084	.896	.514
My favorite places are outside in nature	3.85	1.15	.910	-.053	.877	.521
I spend time outdoors whenever I can	3.81	1.20	.593	.210	.725	.583
I notice plants and animals wherever I am	4.12	0.97	.359	.269	.529	.495
B. Nature-relatedness (NR)—Self (3 items, Cronbach's $\alpha = .828$)	3.55	0.99				
I feel very connected to all living things and the Earth	3.53	1.17	-.009	.849	.527	.844
My relationship to nature is an important part of who I am	3.58	1.16	.166	.740	.633	.844
I think about how what I do affects the Earth	3.56	1.10	-.085	.731	.376	.677

Note. Items rated on scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. PAF analysis indicated an optimal two-factor solution (with Eigenvalues > 1.0) that accounted for 62.3% of the variance; Rotations converged in nine iterations.

**Figure 1.** The “Inclusion of Nature in Self” Scale as it appeared on the survey instrument for middle school youth.

factor explained more than 56% of the variation. After aggregation, resulting CTN index values ranged from 3 to 15 and the combined-scale Cronbach's alpha value was .803. To facilitate interpretation, we subtracted 3 from this score so that 0 = *no connection* and 12 = *complete connection*.

We examined predictors of outdoor time and screen time (both coded as continuous variables, as noted above) and CTN using ordinary least squares (OLS) regression models with the demographic predictors gender (with male as the reference category), race (with dummy variables relative to reference category of White), and grade (sixth, seventh, or eighth, treated as a continuous variable). We also examined the relative influence of outdoor time and screen time on CTN using an OLS regression model. Mean differences among different groups were graphically compared using 95% confidence intervals.

Results

Descriptive Statistics for the Sample

All youth in our sample of 543 were students in sixth (16%), seventh (45%), or eighth grade (39%). Over half of the sample was female (56%) and identified as White (59%), with other racial/ethnic representation including African Americans (26%), Hispanic/Latinos (5%), and Other racial/ethnic groups (10%). The ages of youth participants ranged from 11 to 14 ($M = 12.9$ years, $SD = 0.74$). School data were available for 91% of participants, revealing that most students in the sample (75%) attended Title 1 schools (i.e., schools with high percentages of children from low-income families).

Outdoor Time and Screen Time

We found that almost 70% of rural middle school students reported spending an average of at least 30 min outdoors in nature each day, with 40% spending more than 2 hr ($M = 1.69$ hr, $SD = 1.57$). Our regression model showed that outdoor time differed by demographic group, with males and White students more likely to spend time outdoors (Figure 2 and Table 2). Lower levels of outdoor time were reported by females and African Americans. Youth did not report significant differences in outdoor time across different grade levels.

Rural middle school students reported spending an average of about 30 additional minutes using electronic media ($M = 1.97$ hr, $SD = 1.67$) compared with time spent outdoors. We found that about 75% of participants reported an average of at least 30 min of screen time each day, with 43% spending more than 2 hr. We also found that outdoor time and screen time were inversely related ($r = -.292$, $p < .001$). Screen time was higher than outdoor time for almost every demographic group, with the higher rates of

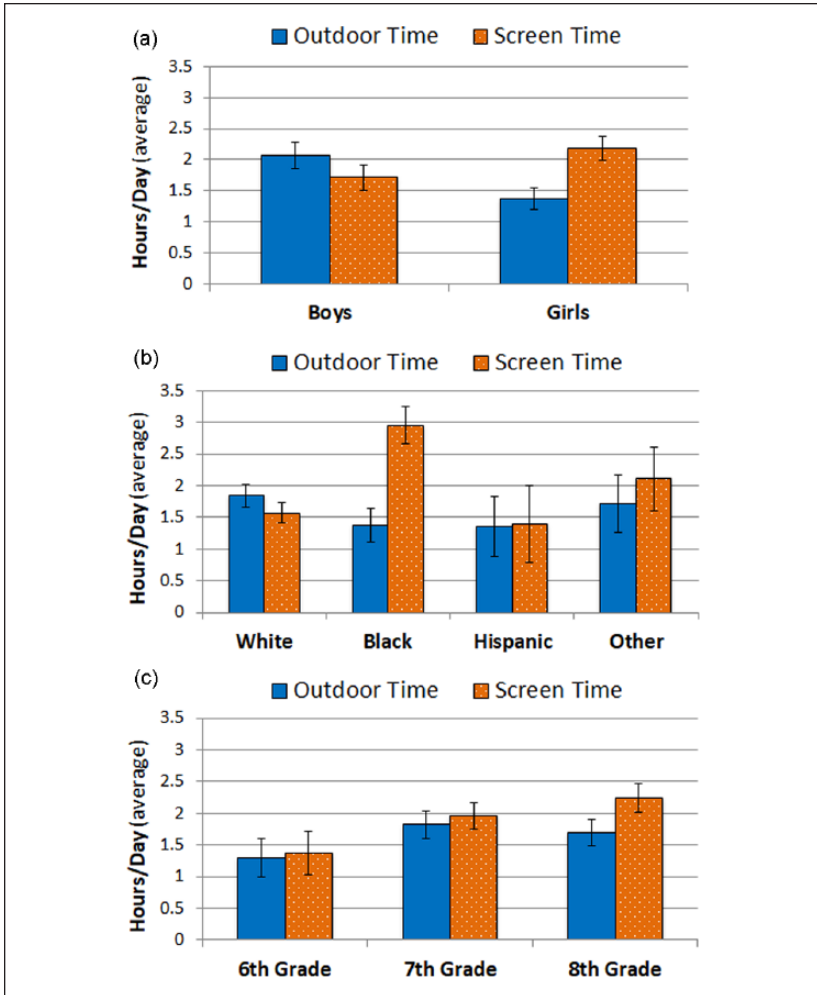


Figure 2. Mean differences (with 95% CI) in rural middle school youth's self-reported daily outdoor time and screen time (i.e., media use) by (a) gender, (b) race/ethnicity, and (c) grade ($n = 533$).

Note. CI = confidence interval.

screen time observed for females, African American youth, and youth from "other" racial backgrounds (Figure 2 and Table 2). Screen time also increased significantly for students in each grade, reaching its highest levels in eighth graders (Figure 2 and Table 2).

Table 2. Standardized Parameter Estimates and Significance Levels for Ordinary Least Squares Regression Models Examining Demographic Predictors of Middle School Youth's Self-Reported Outdoor Time and Screen Time ($n = 533$).

Demographic variables	Outdoor time ^a		Screen time ^a	
	Standardized β	Sig. (p)	Standardized β	Sig. (p)
Race ^b				
African American/Black	-.098	.027	.344	<.001
Hispanic/Latino	-.058	.176	-.023	.560
Other	-.033	.443	.122	.003
Gender				
Female	-.205	<.001	.112	.006
Grade	.039	.359	.176	<.001
Model fit	Adjusted $R^2 = .053$		Adjusted $R^2 = .163$	

^aBoth outdoor time (time in nature) and screen time (time with media) were self-reported by youth based on the following prompt: "In the past week, including Saturday and Sunday, about how many hours per day did you spend outdoors (or with media)?"

^bWhite

CTN

Our sample of rural middle school students reported moderately high levels of CTN on the NR-experience subscale ($M = 3.93$, $SD = 1.01$), NR-self subscale ($M = 3.55$, $SD = 0.99$), and the INS scale ($M = 3.40$, $SD = 1.32$), resulting in overall CTN index scores that ranged from 0 to 12 ($M = 7.64$, $SD = 2.92$). About 92% of students scored above the midpoint value of 6 on the CTN index and 58% scored above 10. Our regression model showed that reported CTN was higher for males, White youth, and students in lower grades (Figure 3 and Table 3), reflecting patterns similar to those observed for the time outdoor variable. After examining these demographic differences, we also tested a separate regression model examining the influence of outdoor time and screen time on CTN. We found that outdoor time was a significant positive predictor ($\beta = 0.37$, $p < .001$), screen time was a significant negative predictor ($\beta = -.280$, $p < .001$), and both variables jointly explained a significant portion of the variance in CTN (Adj. $R^2 = .274$).

Discussion

This study of middle school students in South Carolina suggests that most rural youth are spending time outdoors, and many of them are connected to nature. For example, more than 40% of youth said that they spend an average

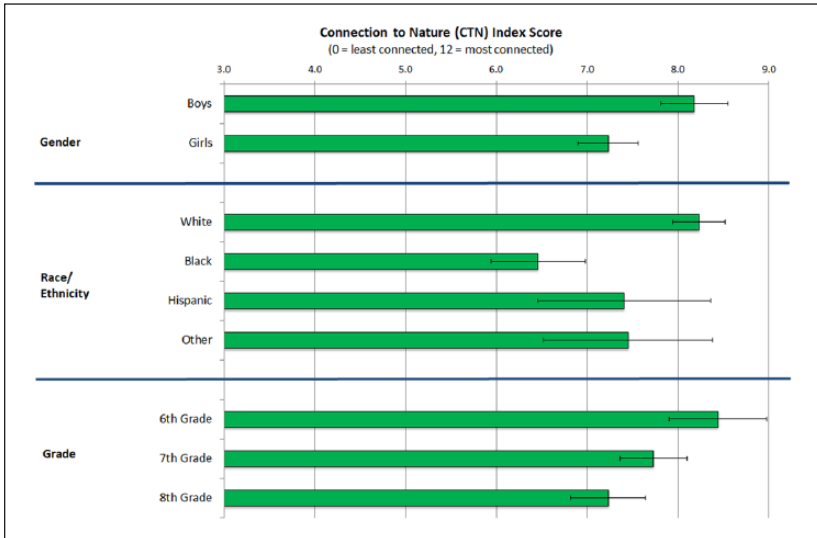


Figure 3. Mean differences (with 95% CI) in rural middle school youth's self-reported connection to nature (CTN) by gender, race/ethnicity, and grade ($n = 533$).
Note. CI = confidence interval.

Table 3. Standardized Parameter Estimates and Significance Levels for Ordinary Least Squares Regression Models Examining Demographic Predictors of Middle School Youth's Self-Reported Connection to Nature ($n = 537$).

Demographic variables	CTN ^a	
	Standardized β	Sig. (p)
Race ^b		
African American/Black	-.253	<.001
Hispanic/Latino	-.059	.160
Other	-.105	.014
Gender		
Female	-.144	.001
Grade	-.148	<.001
Model fit	Adjusted $R^2 = .103$	

^aConnection to nature (CTN) index scores were based on aggregate index of the Nature Relatedness–Experience subscale (four items, rated from 1 = *strongly disagree* to 5 = *strongly agree*), the Nature Relatedness–Self subscale (three items, rated from 1 = *strongly disagree* to 5 = *strongly agree*), and the Inclusion of Nature in Self Scale (one item, where 1 = *no connection*, 5 = *complete connection*). Index scores were calculated by summing the scores on these three metrics and subtracting 3 (so that the lowest possible scores would be 0). CTN scores ranged from 0 = *very low connection* to 12 = *very high connection*.

^bWhite

of 2 or more hours outdoors in nature each day, and mean scores for all CTN scales were on the positive end of the spectrum (i.e., above the neutral point). These patterns appear to support findings in other studies that rural youth may be more engaged in the outdoors than is true of their urban counterparts (Sandercock, Angus, & Barton, 2014). For instance, a Canadian study found rural youth spend 0.7 more hours (about 42 min) outdoors per day than their urban peers (Matz, Stieb, & Brion, 2015). Considering recently reported patterns in children's time outdoors, these results are encouraging as they support notions that rural youth may be more likely to realize the benefits of exposure to nature than their urban counterparts (Stevenson, Peterson, & Dunn, 2017).

However, results also revealed several troubling trends for rural youth. The outdoor time self-reported by participants in our sample was substantially lower than the parent-reported outdoor time for youth ages 10 to 15 in a national study conducted about 10 years ago (from 2007 to 2009; Larson, Green, & Cordell, 2011). Screen time also appeared to eclipse outdoor time for most individuals in our sample. Furthermore, these two activities were significantly and inversely related, meaning that excessive screen time has the potential to decrease youth time outdoors. Increased screen time was negatively associated with CTN, potentially affecting positive youth development (Chassiakos et al., 2016; Larson & Verma, 1999) and future environmental engagement (Chawla, 2007; Wells & Lekies, 2006). Other studies have documented similar inverse relationships between electronic media use and physical activity as well as direct correlations between sedentary media time and health measures such as body fatness and obesity (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Sisson et al., 2010). Collectively, these findings highlight the need for future research to explore links between screen time, outdoor time, and physical health metrics.

Pronounced differences in outdoor time, screen time, and CTN among different demographic groups are particularly concerning. For example, girls reported lower levels of outdoor time and higher levels of screen time, supporting prior research indicating that media use is higher among teenage girls and outdoor activity is higher among boys (Aziz & Said, 2011; Seaman et al., 2014). These activity patterns appeared to be related to lower levels of CTN in girls. Gender discrepancies in leisure time activity levels may be the result of different social norms and interests regarding interaction with the outdoors (Christian et al., 2017) and/or lower levels of parent-granted independent mobility among girls (Alparone & Pacilli, 2012; Carver, Timperio, & Crawford, 2012).

Racial/ethnic minorities, especially African Americans students, appeared to spend more time with electronic media and less time outside than their

White classmates. As would be expected, their CTN was lower as well. These observations align with other studies. For instance, national data sets suggest that African American children do not spend as much time outdoors as Hispanics or Whites (Outdoor Foundation, 2018). Even when African American children are outdoors, research indicates that they are more likely to use electronic devices than are children from other demographic groups and more likely to choose leisure time activities that involve electronic media (e.g., Internet, video games; Larson, Green, & Cordell, 2011). Similar racial/ethnic differences in nature-based recreation have been observed in adults (Dwyer, 1994; Johnson, Bowker, English, & Worthen, 1998; Shinew, Floyd, & Parry, 2004), and these cultural norms and values likely influence children's outdoor leisure activities and CTN (McFarland, Zajicek, & Waliczek, 2014). More research is needed to understand the factors that influence the outdoor time of youth from different racial/ethnic backgrounds (Shinew et al., 2006), with a particular emphasis on African Americans.

Age was also a significant predictor for some variables. While reported levels of outdoor time remained relatively constant across grades, screen time increased and CTN decreased as youth moved from sixth to eighth grade. Other research has documented similar patterns. For example, Larson, Green, & Cordell (2011) found that youth ages 13 to 19 displayed lower levels of outdoor recreation participation compared with children ages 6 to 12. Other research has revealed a decrease in children's affinity for nature-based activities at the onset of adolescence (Larson, Green, & Castleberry, 2010; Leeming, Dwyer, & Bracken, 1995). Multiple factors could explain this shift in outdoor recreation behavior. Older youth often have less free time as schedules become filled with school and family activities (Skar & Krogh, 2009). Teenagers might be more inclined to participate in social activities, interacting with peers instead of interacting directly with nature (Vadala, Bixler, & James, 2007). Peer driven social norms can also encourage high levels of media use (Garcia, Sirard, Deutsch, & Weltman, 2016). Overall, our results support those of other studies highlighting the prominent negative influence that escalating screen time can have on teens' outdoor time and CTN (Kellert et al., 2017).

Limitations

As with any youth survey, several potential sources of bias arose during data collection (e.g., Choi & Pak, 2005). We attempted to limit potential for bias as much as possible through the use of trained study staff, assurances of anonymity, and the use of appropriate classroom management techniques during survey administration. Of particular concern in this study were bias due to

mode of survey administration (Bowling, 2005) and social-desirability response bias (DeMaio, 1984). Although findings regarding differences based on survey implementation mode are mixed, Bowling (2005) reported minimal variation in self-administered questionnaire responses between paper and electronic formats. Constructs of interest in the present study were unlikely to be influenced by social-desirability bias because they did not entail overtly desirable attributes or activities; however, some evidence suggests that screen time is often underreported (Melkevik, Torsheim, Iannotti, & Wold, 2010) and nature-related outcomes are often overreported (Stern, Powell, & Hill, 2014). Therefore, if anything, actual differences in screen time versus outdoor time may be even more pronounced than those reported by youth in our sample.

Ultimately, more research is needed to better understand the connections between declining outdoor time, escalating screen time, and CTN. In our study, outdoor time and screen time were self-reported and broadly defined. Furthermore, unlike other studies, we did not distinguish between outdoor time and screen time on weekdays versus weekend (Larson, Green, & Cordell, 2011) or during school time versus leisure time (Melkevik et al., 2010). Although our coarse estimates of youth time use are useful for relative comparisons, uncertainty surrounding the accuracy of the absolute values makes comparisons with other samples and across different time periods difficult. More objective and precise measures incorporating different dimensions of both outdoor time (e.g., nature-based vs. other) and screen time (e.g., inside vs. outside the home) could be collected via detailed youth time diaries (Hofferth & Sandburg, 2001; Rideout et al., 2010), perhaps coupled with GPS tracking of movement and activity patterns (Cooper et al., 2010). Such an approach would minimize the limitations of recall bias associated with self-reported survey responses and allow for more precise estimates of youth time use across different contexts (e.g., weekdays vs. weekends, in school vs. out-of-school). Data regarding the “greenness” of school and community environments, which has been shown to influence both outdoor activity and screen time among youth (Sanders, Feng, Fahey, Lonsdale, & Astell-Burt, 2015) could also be considered as a mediating variable. The current convenience sample could be expanded as well to include a more diverse and representative cross section of rural populations in other states, as well as urban youth. For example, Rideout (2015) reported socioeconomic differences in access to and use of media; therefore, future work should examine these relations among socioeconomically diverse youth.

Although outdoor time and screen time were inversely related, the strength of the relationship was moderate. Hence, there appears to be heterogeneity in how youth spend their time. Future research with larger samples could

identify profiles of youth time use in terms of outdoor and screen time, and examine whether particular profiles (e.g., low screen time and high outdoor time vs. high screen time and high outdoor time) are linked to positive youth outcomes. The substantial portion of unexplained variance in our models suggest that many other sociocultural variables should be considered when attempting to explain observed relationships. For example, a lack of access to suitable recreation sites is often a barrier to activity in minority and low-income communities (Grow et al., 2008; Larson, Green, & Cordell, 2011; Weir et al., 2006), where safety concerns and the need for adult supervision constrain children's independence and outdoor play (Karsten, 2005; Timperio, Crawford, Telford, & Salmon, 2004; Veitch, Bagley, Ball, & Salmon, 2006). Parents and guardians also play an important role in this process. Parental behavior (e.g., coparticipation, modeling) encouraging less screen time and more unstructured outdoor time can have a strong effect on youth (Lovelock et al., 2016), and research highlights the powerful influence of parent perceptions on youth activity in natural settings (Barnett & Weber, 2008; Larson, Whiting, & Green, 2013; McFarland et al., 2014). For middle schoolers, the social influence of siblings, friends, and neighbors also affects screen time and outdoor activity (Garcia et al., 2016). Future research should account for the influence of these social factors on children's leisure time. Finally, future research could also broaden consideration of outcomes variables that extend beyond CTN to assess impacts of outdoor time and screen time on other facets of children's health and positive youth development (Seaman et al., 2014).

Conclusion and Recommendations

Our study indicates that screen time may be a key factor linked to declines in both outdoor time and CTN, even in rural populations of youth. As students age, the problem intensifies. Even if outdoor time remains relatively stable as children age, increasing screen time may still have a detrimental impact on CTN throughout the adolescent years. These negative relationships appear to be most significant for females and youth of color (particularly African Americans). Tests of interaction effects across gender, racial/ethnic, and age groups in a larger sample would help researchers understand if certain sub-populations (e.g., older African American girls) are at greater risk than other demographic segments.

For all of the reasons, researchers and practitioners need to examine the forces fueling these troubling findings and identify ways to mitigate them. One potential solution is an increased emphasis on "nearby nature," or outdoor recreation opportunities that provide a variety of benefits close to home (Chawla, 2015; Pyle, 2002; Wells & Evans, 2003). Such an approach could

work particularly well for youth in rural areas, where access to nature is often just beyond the doorstep. A nearby nature emphasis could be particularly important for girls, whose outdoor time and physical activity increases substantially when appealing youth-related destinations and activities (nature-based or otherwise) are available in surrounding areas (Christian et al., 2017). Programming efforts targeting girls and youth of color could capitalize on this opportunity, finding ways to integrate any form of outdoor time for groups who are less likely to experience it on their own.

Another potential alternative might involve a creative merger of electronic media and outdoor time to promote nature connection. Our study indicates that electronic media usage increases as teenage years progress and was often associated with weaker CTN. But other research reveals that listening to music, watching movies, and using electronic media outside are among the most commonly reported outdoor activities for youth across all demographic groups (Larson, Green, & Cordell, 2011). There may therefore be creative ways to embrace this connection and integrate children's passion for electronic media with their affinity for the outdoors through technology-centered activities in outdoor settings (Chavez, 2009). For example, mobile applications in nonformal environmental education programming are successfully connecting children to nature while providing an engaging experience for youth (Crawford, Holder, & O'Connor, 2017). Other research suggests that augmented reality technology such as Pokémon Go could encourage outdoor behavior, or at least facilitate technology-mediated outdoor engagement (Dorward, Mittermeier, Sandbrook, & Spooner, 2017). Teens, in particular, might benefit from such programs. In short, although screen time typically detracts from outdoor time, the two may not always be mutually exclusive. Inspiring CTN among future generations will likely require a little of both.

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