

# A Growing Disconnection From Nature Is Evident in Cultural Products

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## Abstract

Human connection with nature is widely believed to be in decline even though empirical evidence is scarce on the magnitude and historical pattern of the change. Studying works of popular culture in English throughout the 20th century and later, we have documented a cultural shift away from nature that begins in the 1950s. Since then, references to nature have been decreasing steadily in fiction books, song lyrics, and film storylines, whereas references to the human-made environment have not. The observed temporal pattern is consistent with the explanatory role of increased virtual and indoors recreation options (e.g., television, video games) in the disconnect from nature, and it is inconsistent with a pure urbanization account. These findings are cause for concern, not only because they imply foregone physical and psychological benefits from engagement with nature, but also because cultural products are agents of socialization that can evoke curiosity, respect, and concern for the natural world.

## Keywords

nature, language, culture, cultural change, content analysis, well-being, sustainability

In January 2015, a number of high-profile writers penned an open letter to Oxford University Press, protesting at a choice of words for *Oxford Junior Dictionary's* newest edition. They expressed concern that the new edition had eliminated many words related to nature, such as *canary*, *clover*, *pasture*, and *blackberry*, to make room for neologisms such as *attachment*, *blog*, *voice-mail*, and *BlackBerry* (Flood, 2015). The letter said, “In light of what is known about the benefits of natural play and connection to nature; and the dangers of their lack, we think the choice of words to be omitted shocking and poorly considered” (Flood, 2015).

This letter is only one of the many cultural voices that lament the weakening connection with the natural world. Over the last few decades, several nature lovers and conservation scientists have written about the joys and benefits of connecting with nature and the dangers of losing that connection (e.g., Balmford & Cowling, 2006; Kareiva, 2008; Miller, 2005; Nabhan & Trimble, 1995; Pyle, 2003). One writer introduced the term *nature-deficit disorder* to describe the growing distance between children and nature (Louv, 2008) and wondered, “as the care of nature increasingly becomes an intellectual concept severed from the joyful experience of the outdoors, you have to wonder: Where will future environmentalists come from?”

(Louv, 2008, pp. 146–147). Another author asked “What happens to a species that loses touch with its habitat?” (Pyle, 2007).

Empirical evidence is in strong agreement with these authors’ two main arguments: Contact with nature is greatly beneficial to human well-being, and it is associated with environmentally protective attitudes and behaviors.

A large number of studies show that connecting with nature contributes to physical and psychological health (for reviews, see Bratman, Hamilton, & Daily, 2012; Hartig, Mitchell, De Vries, & Frumkin, 2014). For example, hospital patients assigned to rooms with foliage and flowers fare better after surgery (Park & Mattson, 2008), as do patients with a window giving them a scenic view (Ulrich, 1984). Office windows looking out onto natural views buffer workers from the negative impact of work strain (Leather, Pyrgas, Beale, & Lawrence, 1998) and are associated with more positive work attitudes and higher job satisfaction (Kaplan, 1993). Whether it is viewing pictures

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of lakes and hills or walking through a park, exposure to nature leads to faster stress recovery, mental restoration, and improved cognitive functioning (Berman, Jonides, & Kaplan, 2008; Berto, 2005; Ulrich et al., 1991). Exposure to nature also increases prosocial attitudes and behaviors (Weinstein, Przybylski, & Ryan, 2009; Zelenski, Dopko, & Capaldi, 2015). Finally, people who live near green spaces report better mental health and well-being—an effect that holds after controlling for various individual and neighborhood characteristics (White, Alcock, Wheeler, & Depledge, 2013).

In addition to health and well-being, contact with nature has also been linked to pro-environmental attitudes and behaviors (e.g., Finger, 1994; Nord, Luloff, & Bridger, 1998; Teisl & O'Brien, 2003). For example, people who report having played in wild environments as children express greater affinity and appreciation for nature (Bixler, Floyd, & Hammitt, 2002). In turn, emotional affinity for nature is associated with environmentally protective behaviors (Hinds & Sparks, 2008; Kals, Schumacher, & Montada, 1999; Nisbet, Zelenski, & Murphy, 2008). In one experiment, participants who viewed a brief video of natural spaces engaged in more sustainable behaviors than did participants who viewed a video of human-built spaces (Zelenski et al., 2015).

### Measuring Connectedness to Nature at the Collective Level

Given the strong evidence for the salutary effects of contact with nature, it is important to understand how and why it varies across individuals and collectives. At the individual level, there has been growing interest in investigating connectedness to nature along with its antecedents and consequences (e.g., Mayer & Frantz, 2004; Nisbet et al., 2008; Schultz, 2002; Sparks, Hinds, Curnock, & Pavey, 2014). At the collective level, our knowledge is more limited. Although it is a widely accepted truism that people have been growing gradually apart from nature, empirical evidence is scarce on the patterns of change in the human–nature connection.

The dearth of such evidence partially stems from the difficulty of capturing the diffuse set of behaviors that comprise “contact with nature.” One such attempt used urban butterfly extinctions since 1959 as a proxy for “the extinction of experience” (Pyle, 2002). The author reasoned that urban butterfly extinctions track the degree of natural change in cities and thereby the lost opportunities for contact with nature. He found that opportunities for experiencing nature have been declining in the cities studied—particularly in those undergoing the most rapid levels of suburbanization.

A second approach to indexing contact with nature at the collective level is through tracking time spent on

nature-based activities. Studies using this type of measure have documented declining per capita visits to protected areas in the United States and Japan since the late 1980s (Pergams & Zaradic, 2006, 2008). However, this trend is not observed in some other countries, such as India and Ghana, where nature-based tourism has grown in the same period (Balmford et al., 2009). Moreover, time-tracking measures capture limited and relatively infrequent types of contact with nature and are not necessarily prognostic of time spent on more prosaic activities such as watching a sunset, listening to birds chirping, or tending one’s garden.

A third approach to measuring collective-level connection to nature is by tracking people’s knowledge about the natural world. Ecological literacy declines with increasing livelihood independence from nature and is consequently lower in affluent communities (Pilgrim, Cullen, Smith, & Pretty, 2008). A 2002 study, for example, found that an average 8-year-old British child could identify 78% of all Pokémon characters but only 53% of common British wildlife species (Balmford, Clegg, Coulson, & Taylor, 2002). Although such snapshots are striking and informative, representative and longitudinal evidence on ecological knowledge is scarce.

### Measuring Connectedness to Nature Through Cultural Products

Cultural products such as books, magazines, and advertisements carry the footprints of the social context in which they were created. As such, their study can offer clues to the long-term cultural dynamics in play (DeWall, Pond, Campbell, & Twenge, 2011; Greenfield, 2013; Kashima, 2014; Morling & Lamoreaux, 2008). To obtain an alternative collective-level measure of connectedness to nature across time, we have turned to cultural products: We have tracked the relative frequency of references to nature in fiction books, song lyrics, and movie storylines.

For two reasons, we consider references to nature in cultural products to be a valid measure of connectedness to nature. First, cultural products reflect their creators’ minds, which are in turn shaped by the surrounding social scene (Markus & Kitayama, 2010). The creative process requires creators to access elements of conceptual knowledge stored in their minds and to combine these elements (Ward & Kolomyts, 2010). This means that nature-related concepts can make their way into cultural products if they are stored in the minds of cultural creators and are cognitively accessible to them. As cognitive accessibility is a function of a concept’s recency and frequency of use (Higgins, 1996), recurring encounters with nature would render nature-related concepts more accessible and thereby increase the odds that they will feature in cultural

creations. Conversely, if creators have limited encounters with nature or if these encounters do not register with them, nature is less likely to feature in their work.

Our second reason for considering references to nature to be a valid measure of connectedness to nature has to do with the pragmatics of communication. Communicators strive to maximize the relevance of their messages to their audiences (Grice, 1975). Novelists, songwriters, and filmmakers would consequently be more likely to refer to nature if they expected nature to evoke an interest in, and elicit a response from, their audiences. In contrast, they would be less likely to refer to nature, if they did not expect nature to resonate with their audiences.

For these two reasons, references to nature in cultural products are expected to covary with levels of connectedness to nature across time. Some scholars have already argued for a growing isolation from nature based on a similar approach. A study of references to 22 tree names in the *Oxford English Dictionary* entries between the 16th and 20th centuries found a precipitous decline in numbers after the 19th century (Wolff, Medin, & Pankratz, 1999). In the realm of popular culture, a study of 60 Disney and Pixar animated films made between 1937 and 2009 found a decline in the depiction of outdoor scenes and less biodiversity in the natural settings portrayed (Prévot-Julliard, Julliard, & Clayton, 2014). Another study looked at 296 children's books that won Caldecott awards from 1938 to 2008 and found a significant decline in portrayals of natural environments and animals, as well as an increase in the portrayals of human-built environments (Williams, Podeschi, Palmer, Schwadel, & Meyler, 2012).

To test the validity and generalizability of these findings in the wider popular culture, we explored representations of nature in three genres of cultural production: fiction books, song lyrics, and films. We first created a lexicon of 186 nature-related words comprising of four categories: general words related to nature, names of flowers, names of trees, and names of birds. We then obtained the relative appearance frequency of this set of words in a large number of cultural products (a minimum of 5,924 per genre) over time.

### Conceptualization of Nature and Creation of a Nature Lexicon

The concept of nature is socially constructed and varies across cultures (Bang, Medin, & Atran, 2007; Medin & Bang, 2014). As such, any conceptualization of nature, including our own, is not "nature" in some objective or neutral sense but is a particular cultural model with alternatives. In this article, we are adopting the currently dominant cultural model of nature that sees human beings as separate from nature. Based on this conceptualization,

bird nests or mole burrows are categorized as nature but skyscrapers and highways are not. Because of this choice, we talk about the "human connection to nature" instead of "human connection to the rest of nature," and we draw a distinction between the natural environment and the human-made environment.

Our choice of words for the lexicon was dictated by this cultural model of nature as separate from humans. On this basis, we excluded parts of physical or living environments that are appropriated by humans for utilitarian purposes, such as food items or domesticated animals (e.g., *chicken, fruit, crop, cat, timber*).

Three categories of words that are consistent with this conceptualization of nature were further eliminated a priori for theoretical reasons. First, because our theoretical account invokes the role of exposure to nature in rendering nature more cognitively accessible to cultural creators, words were excluded if their referents were not part of the natural habitat of the linguistic communities that produced the creative works studied (e.g., *volcano, glacier, giraffe, desert, jungle*).

Second, because our focus is on people's connection with nature in their everyday lives, we excluded scientific terminology used to describe aspects of the natural world (e.g., *habitat, flora, larvae, organism, ecosystem*).

Third, because we are interested in connectedness to nature as a means of promoting human well-being and affinity for nature, the selection was limited to nonthreatening aspects of natural environments. We thus excluded elements of nature that constitute threats to humans and could detract from their well-being (e.g., *hurricane, earthquake, wildfire*). However, we did include potentially and mildly unpleasant aspects of nature that are part of human habitats and/or could evoke interest in nature (e.g., *storm, insect*).

Within these constraints, we aimed for a comprehensive and unbiased selection of words. To ensure broad coverage, we created three specialized lists for bird, tree, and flower names, in addition to a set of general nature-related words. To guard against bias in the selection of words, we supplemented the initial list of general words we created with entries from participants and relied on preexisting lists for the other three specialized categories instead of making the selection ourselves.

To increase the reliability of our measure, we excluded words with more than one meaning if an alternative meaning was unrelated to nature and the word was frequently used in that sense (e.g., *fall, plain*). In addition, we included both the singular and plural forms of each word with two exceptions: First, we did not include the plural form if a word is typically not used in that form (e.g., *suns, moons*). Second, we did not include a singular form if it had a separate meaning unrelated to nature (e.g., we did a search for *hazels* but not *hazel*).

**Table 1.** List of Nature-Related Words ( $N = 186$ ) by Category**General nature words ( $n = 60$ )**

animal(s), autumn(s), beach(es), bird(s), bloom(s), bud(s), cloud(s), creek(s), dew(s), fish(es), flower(s), fog(s), forest(s), garden(s), grass(es), grove(s), hill(s), hillside, insect(s), lake(s), leaf(ves), lightning(s), meadow(s), mist, moon, moonlight, mountain(s), ocean(s), pasture(s), plant(s), rain(s), rainbow(s), river(s), rock(s), sand(s), sea(s), seaside, season(s), shrub(s), sky(ies), snow(s), soil, spring(s), star(s), stone(s), storm(s), stream(s), summer(s), sun, sunrise(s), sunset(s), sunshine, stump(s), swamp(s), tree(s), twilight(s), wave(s), wind(s), winter(s), wood(s)

**Bird names ( $n = 34$ )**

avocet(s), blackbird(s), bluebird(s), bunting(s), crossbill(s), dove(s), duck(s), egret(s), finch(es), flamingo(s), gallinule(s), goldfinch(s), grosbeak(s), hawk(s), heron(s), hummingbird(s), jay(s), kingfisher(s), lark(s), mallard(s), meadowlark(s), merganser(s), oriole(s), owl(s), pelican(s), redstart(s), robin(s), sparrow(s), spoonbill(s), tanager(s), thrasher(s), towhee(s), warbler(s), woodpecker(s)

**Tree names ( $n = 37$ )**

alder(s), arbutus(es), beech(es), birch(es), cedar(s), cypress(es), dogwood(s), elm(s), fir(s), hawthorn(s), hazels, hemlock(s), hickory(ies), hornbeam(s), juniper(s), laburnum(s), larch(s), magnolia(s), maidenhair(s), maple(s), oak(s), pine(s), poplar(s), redbud(s), redwood(s), rowan(s), sassafras, sequoia(s), sophora(s), spruce(s), sumacs, thuja(s), tupelo(s), whitebeam(s), willow(s), yew(s), zelkova(s)

**Flower names ( $n = 55$ )**

amaranth(s), amaryllis(es), anemone(s), aster(s), azalea(s), begonia(s), bellflower(s), bergamot(s), bluebell(s), bottlebrush(es), buttercup(s), camellia(s), carnation(s), chrysanthemum(s), clover(s), columbine(s), crocus(es), daffodil(s), dahlia(s), daisy(ies), delphinium(s), edelweiss, forget-me-not(s), foxglove(s), freesia(s), gladiolus(es), heather(s), hibiscus(es), hyacinth(s), iris(es), jasmine(s), lavender(s), lilac(s), lily(ies), lotus(es), marigold(s), marjoram(s), mimosa(s), narcissus(es), orchid(s), peony(ies), petunia(s), primrose(s), rhododendron(s), rose(s), rosemary(ies), snapdragon(s), sunflower(s), tansy(ies), thistle(s), thyme(s), tulip(s), violet(s), waterlily(ies), zinnia(s)

**Comparison set: Words about the human-built environment ( $n = 40$ )**

armchair(s), attic(s), bed(s), bedroom(s), bowl(s), brick(s), bridge(s), building(s), carpet(s), ceiling(s), cellar(s), chair(s), corridor(s), couch(s), cup(s), cupboard(s), curtain(s), door(s), drawer(s), furniture, gate(s), glass(es), hall(s), house(s), kitchen(s), lamp(s), pan(s), parlor(s), pavement(s), porch(es), road(s), roof(s), room(s), shelf(ves), sofa(s), stairs, street(s), table(s), wall(s), window(s)

In line with these guidelines, we created the following four lists comprising 186 nature-related words (see Table 1 for the full list of words):

1. *General nature-related words.* An initial list was generated by the authors. Next, 140 participants recruited on Amazon's Mechanical Turk marketplace were asked to generate words related to nature. Participant-generated words were added to the list if they were compatible with the above guidelines. The final list consisted of 60 words (e.g., *hill, river, season, sunset*).
2. *Bird names.* We obtained all bird names listed in the index of *Audubon's Birds of America Coloring Book* (Kennedy, 1974). Multiword entries were reduced to unigrams. For example, entries for *blackburnian warbler*, *cerulean warbler*, and *chestnut-sided warbler* were reduced to *warbler*. We excluded entries that could not be reduced to a unigram (*whip-poor-will*) or had other predominant meanings (*chat, cardinal*). The final list
3. *Tree names.* We obtained all tree names listed in the index of *The Illustrated Book of Trees* (Bourdo, 2001). Again, multiword entries were reduced to unigrams (e.g., *douglas fir* and *silver fir* were reduced to *fir*). We excluded tree names that could not be reduced to unigrams (*boney locust, Indian bean tree*), had other predominant meanings (*ashes, elders*), or were simultaneously fruit names (*limes, pears*). The final list consisted of 37 tree names (e.g., *birch, willow, poplar, cypress*).
4. *Flower names.* We have drawn on a preexisting list of flower names available online at <http://www.namesofflowers.net> (retrieved on 5/19/2015). We included all listed flower names with the exception of those that were not unigrams and/or had other predominant meanings (*lady's slipper, cherry blossom, sage*). The final list consisted of 55 flower names (e.g., *camellia, daisy, marigold, lily*).

In addition to the nature lexicon, we have compiled a comparison set of words related to the human-made environment, in order to test whether the pattern observed for nature-related words is unique or would generalize to other words relating to non-natural human environments. The final list consisted of 40 words such as *building, door, curtain, room, table, and wall* and their plurals. It avoided words denoting relatively recent technology (e.g., *garage, highway*).

## References to Nature in Fiction

In the first study, we tracked the relative frequency with which words related to nature appeared in English works of fiction throughout the 20th century.

### Method

**Corpus.** Data were obtained through the Google Ngram Viewer (<http://books.google.com/ngrams>). This tool is based on a sample of books digitized by Google (Michel et al., 2011). It provides the ratio of an *n*-gram as a percentage of all *n*-grams in the selected subsample of books in the Google Books database.

We selected the English Fiction 2012 corpus that includes books in English published in any country and identified by libraries as fiction books. Some of these books were translated from other languages. Although no metadata are available to establish the precise ratio of translated books in this corpus, it has been estimated that less than 5% of all books published in the United States and United Kingdom are translations—a figure that has been stable since 1945 (Heilbron, 1999). This estimate

suggests that our results are not disproportionately influenced by translated books.

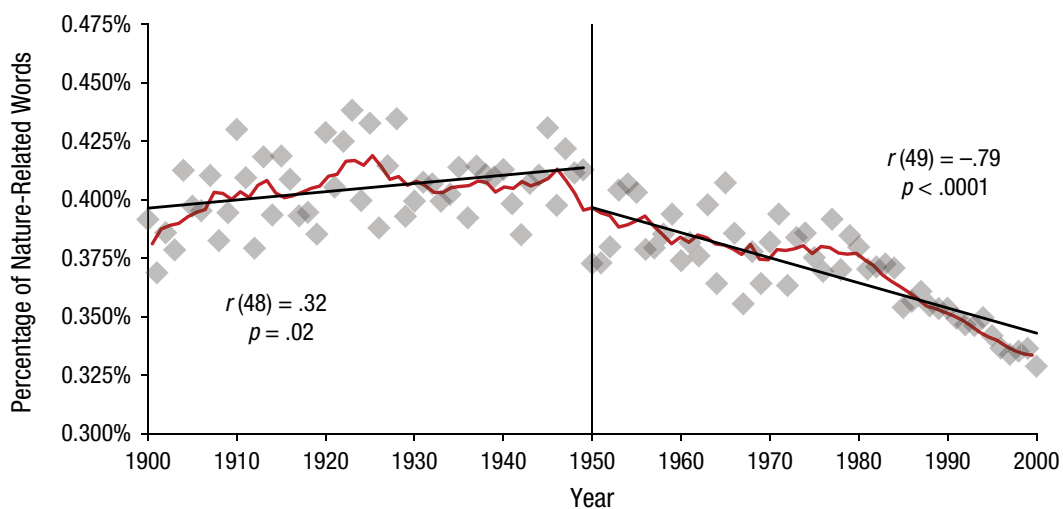
No data were obtained for the period after 2000 because Google changed its sampling procedure after that year such that results before and after are not fully comparable (Michel et al., 2011).

**Measurement procedure.** Measurements were taken using an Excel file with a macro that retrieves data from the Ngram Viewer search page and records it on a worksheet. To increase the precision of the measurement, we have used the tagging feature of the Google Ngram Viewer, which allows limiting the search to certain speech parts (e.g., noun, verb). For example, the searches for *wave* and *rock* were limited to nouns, thereby avoiding their nature-unrelated uses as verbs. We also limited the search to words in lowercase in order to avoid proper names such as last names or place names (for the full list of search terms see Table S1 in the online Supplementary Materials).

Searches were conducted for each year between 1900 and 2000. Ratios for each category of words were obtained by summing the ratios obtained for all words belonging to that category.

### Results

Analyses revealed that across the 20th century, the relative frequency with which the 186 nature-related words appeared in English fiction correlated negatively with their year of appearance,  $r(99) = -0.72$ ,  $p < .0001$  (see Fig. 1). In other words, the appearance frequency of nature-related words significantly declined throughout



**Fig. 1.** Total yearly ratios of 186 nature-related words in English fiction (1900–2000) as a percentage of all words in the corpus for that year. Data were obtained from Google Ngram Viewer. The red line depicts each year's moving average for  $\pm 3$  years. Regression lines show the linear trends for the first half (1900–1949) and second half (1950–2000) of the 20th century.

**Table 2.** Prevalence of Nature-Related Words in Fiction Books (1900–2000)

	Correlation with time			Average % (SD)		Pre-/Post-1950 comparison		
	1900–2000	1900–1949	1950–2000	1900–1949	1950–2000	Change	<i>t</i>	Cohen's <i>d</i>
All words ( <i>N</i> = 186)	-.72**	.32*	-.79**	0.4050 (0.016)	0.3699 (0.020)	-8.7%	9.78**	1.95
General words ( <i>n</i> = 60)	-.63**	.42**	-.77**	0.3584 (0.014)	0.3330 (0.018)	-7.1%	7.71**	1.54
Bird names ( <i>n</i> = 34)	-.44**	.38**	-.74**	0.0065 (0.001)	0.0059 (0.001)	-8.1%	4.66**	0.93
Tree names ( <i>n</i> = 37)	-.82**	.01	-.66**	0.0129 (0.001)	0.0101 (0.001)	-22.3%	18.00**	3.59
Flower names ( <i>n</i> = 55)	-.91**	-.58**	-.66**	0.0273 (0.002)	0.0209 (0.001)	-23.4%	18.29**	3.64

\**p* < .05. \*\**p* < .01.

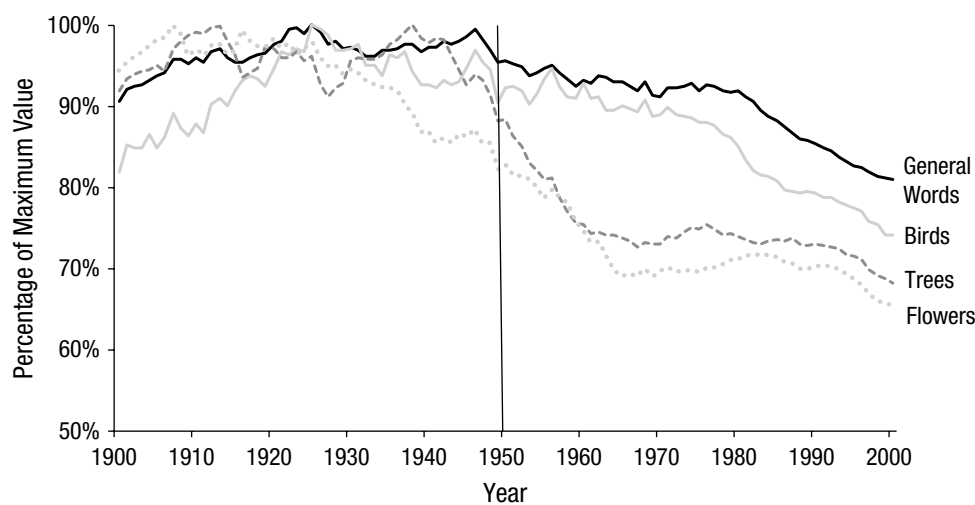
the 20th century. This trend held separately for all four categories of nature-related words investigated,  $-.91 < r(99) < -.44$ , *ps* < .0001 (see Table 2).

A closer look at the data located the decline in the second half of the century (1950–2000). In fact, the trend for the full set of words was positive for the first half-century (1900–1949),  $r(48) = 0.32$ , *p* = .02, and of the four categories, only flower names significantly declined during the first half-century,  $r(48) = -.58$ , *p* < .0001. In contrast, all categories showed strong negative trends after 1950,  $-.77 < r(49) < -.66$ , *ps* < .0001, as did the full set;  $r(49) = -.79$ , *p* < .0001. The correlation coefficients for the two periods in the full set are significantly different from each other,  $z = 6.91$ , *p* < .0001.

To get a better sense of the magnitude of change between pre- and post-1950, we compared the average appearance frequency of nature-related words for the first half of the 20th century (1900–1949) to the average for the second half (1950–2000). For the full set of 186

words, the drop was 8.7% from the first half to the second; Cohen's *d* = 1.95, *p* < .0001. It was 7.1% for the general category (*d* = 1.54), and 8.1% for bird names (*d* = 0.93). The drop in tree and flower names was considerably larger: Tree names dropped by 22.3% (*d* = 3.59), and flower names dropped by 23.4% (*d* = 3.64). Figure 2 provides a comparison of the four categories.

These findings demonstrate that references to nature declined in works of fiction after, but not before, the 1950s. To test whether this decline was specific to nature-related words or reflected a broader decline pattern for words related to human environments, we tracked the appearance ratio of 40 nouns related to *human-made* environments (e.g., *bed*, *bowl*, *brick*, *hall*). Unlike nature-related words, this set of words exhibited a positive trend over the same period;  $r(99) = 0.62$ , *p* < .0001. The positive trend was evident in both the first half of the century,  $r(48) = .91$ , *p* < .001, and the second,  $r(49) = .50$ , *p* < .001.



**Fig. 2.** Ratio of nature-related words in English fiction by category, as a percentage of the maximum value for that category (1900–2000). We calculated  $\pm 3$  year moving averages separately for each category of words. The depicted lines show the ratio of each year's moving average as a percentage of the maximum moving average for that category.

## References to Nature in Song Lyrics

A hit song by Johnnie Ray in 1952 was titled “Please Mr. Sun.” It went “Talk to her please, Mr. Sun / Speak to her, Mr. Rainbow / And take her under your branches Mr. Tree / Whisper to her, Mr. Wind / Sing to her, Mr. Robin / And Mrs. Moonlight / Put in a word for me.” These lyrics sound somewhat out of place in the popular music culture of the early 21st century, suggesting a shift in the narrative tone of this genre away from nature themes. To test for such a change, we next tracked the appearance frequency of nature-related words in a corpus of popular songs that made it to Top 100 lists between 1950 and 2011.

### Method

**The corpus.** We obtained lyrics of songs listed as the top 100 songs each year between 1950 and 2011 from a website (<http://songlyrics.com>; retrieved on 6/21/2014). The website did not include lyrics for some of the 6,200 listed works, in particular those from earlier years, and some entries were instrumental pieces. The final corpus contained 5,924 songs of various musical genres (e.g., pop, jazz, country, Christian) and consisted of approximately 1.7 million words.

A fraction of these songs did not originate from Anglophone countries (i.e., Australia, Canada, Ireland, New Zealand, the UK, and the US). To obtain an estimate, we randomly chose five songs from each year’s top 100 list and checked the national origin of the singer or the band. Even though singers often did not write their song lyrics and they do not necessarily have the same national origin as their lyrics writers, we used this proxy because of the

limited data available on lyrics writers. Of the 320 songs sampled, 6 (1.9%) were sung by artists from outside of the Anglosphere (e.g., *The Sign* by Swedish pop group Ace of Base). This low ratio indicates that our results are not disproportionately influenced by the work of non-Anglophone artists.

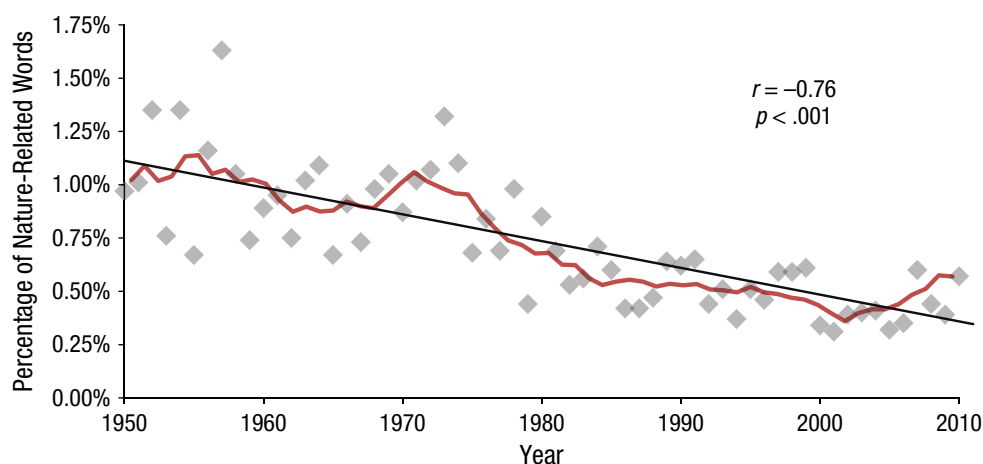
**Measurement.** To measure relative word frequency, we used the Linguistic Inquiry and Word Count (LIWC) program (Tausczik & Pennebaker, 2010). The LIWC software computes the appearance frequency of a given set of words as a percentage of the total number of words in a corpus.

We created a LIWC dictionary comprised of the same 186 words related to nature as in the analyses of fiction books above, and the same 40 words related to the human-made environment (the dictionary is available in Table S2 in the online Supplementary Materials). Unlike Google Ngram, LIWC does not differentiate between parts of speech (e.g., verbs vs. nouns) or between uppercase and lowercase letters. The query thus picked words used in all parts of speech and was not case sensitive.

### Results

Analyses revealed that references to nature followed a declining pattern in this corpus as well (see Fig. 3). The correlation between the appearance frequency of nature-related words and year of origin was  $-.76$ ,  $p < .0001$ . This negative pattern held for all four categories of words,  $-.71 < r_s(60) < -.42$ ,  $p_s < .0007$  (see Table 3).

Over the same period, references to the human-made environment showed a marginally significant negative trend,  $r(60) = -.23$ ,  $p = .07$ . Supporting the uniqueness of



**Fig. 3.** Total yearly ratios of 186 nature-related words in popular song lyrics (1950–2011) as a percentage of all words in the corpus of song lyrics for that year. Lyrics of songs that made it to that year’s Top 100 were obtained from [www.songlyrics.com](http://www.songlyrics.com). We analyzed 5,924 song lyrics using text analysis software (LIWC). The red line depicts each year’s moving average for  $\pm 3$  years.



**Table 3.** Prevalence of Nature-Related Words in Popular Song Lyrics (1950–2011)

	Correlation with time (1950–2011)	Average % (SD)
All words ( $N = 186$ )	-.76**	0.729 (0.30)
General words ( $n = 60$ )	-.71**	0.667 (0.26)
Bird names ( $n = 34$ )	-.42**	0.019 (0.03)
Tree names ( $n = 37$ )	-.53**	0.008 (0.01)
Flower names ( $n = 55$ )	-.58**	0.035 (0.04)

\*\* $p < .01$ .

the decline for nature-related words, the correlation coefficient for nature-related words was significantly different from the coefficient for words related to the human-made environment,  $z_{diff} = 3.97$ ,  $p < .0001$ .

The magnitude of the decrease in song lyrics is much larger than that found in works of fiction. The appearance ratio of nature-related words dropped from 1.07% in the 1950s (1950–1959) to 0.40% in the first decade of the 21st century (2000–2009)—a decline of 63%. This means that for every three nature-related words in the popular songs of the 1950s, there was only barely more than one 50 years later.

### References to Nature in Film Storylines

To test whether the findings would generalize to a different genre of cultural production, we next tracked the usage frequency of nature-related words in film storylines.

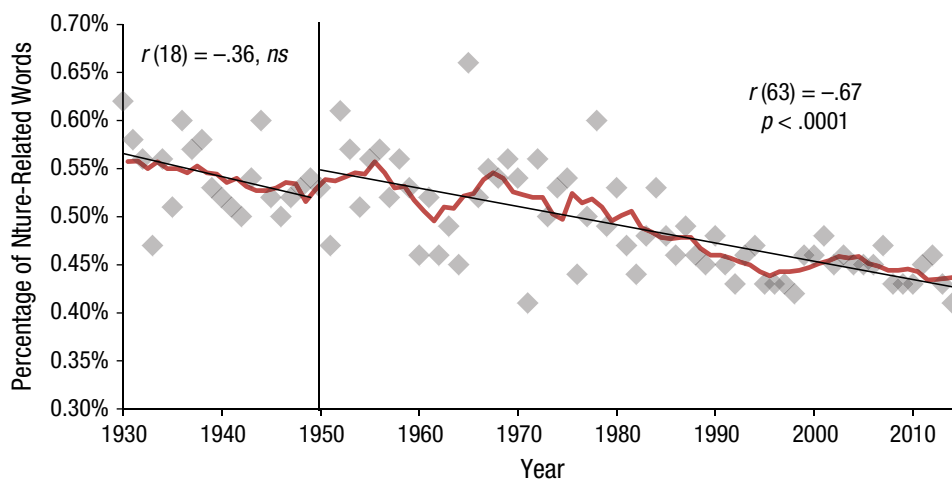
### Method

**The corpus.** We retrieved all English titles available on www.IMDb.com from 1930 to 2014. Analyses were limited to the subset of the retrieved titles that included a storyline, and could thus be submitted to text analysis, and originated from a country in the Anglosphere (Australia, Canada, Ireland, New Zealand, the United Kingdom, and the United States). The final set had 274,011 entries, of which 49,246 (18.0%) were listed as documentaries. The number of entries grows exponentially with time, such that 75.7% of the titles are dated 2000 or later. The total number of words in the corpus was approximately 16.1 million.

**Measurement.** Using LIWC with the same dictionary as before, we obtained the frequency of nature-related words in the storylines for each year as a percentage of the total number of words for that year. To test for convergent validity, we also obtained separate frequencies for entries that included “Documentary” in their genre description and those that did not.

### Results

In this corpus as well, references to nature did decline steadily over the period covered,  $r(83) = -.70$ ,  $p < .0001$  (see Fig. 4). The correlations were significantly negative for general words,  $r(83) = -.60$ ,  $p < .0001$ , and bird names,  $r(83) = -.62$ ,  $p < .0001$ . They were not significant for tree names,  $r(83) = 0.17$ , *ns*, and flower names,  $r(83) = -.10$ , *ns*.



**Fig. 4.** Yearly ratios of 186 nature-related words in film storylines (1930–2014), as a percentage of all words in the storyline corpus for that year. Film storylines were obtained from the Internet Movie Database (www.IMDb.com). We analyzed 274,011 storylines using text analysis software (LIWC). The red line depicts each year’s moving average for  $\pm 3$  years. Regression lines show the linear trends for the period before 1950 (1930–1949) and after 1950 (1950–2014).



**Table 4.** Prevalence of Nature-Related Words in Film Storylines (1930–2014)

	Correlation with year (1930–2014)	Average % ( <i>SD</i> )		Pre-/Post-1950 comparison		
		1930–1949	1950–2014	Change	<i>t</i> (83)	Cohen's <i>d</i>
<b>All Films (<i>N</i> = 274,011)</b>						
All words ( <i>N</i> = 186)	-.70**	0.543 (0.04)	0.488 (0.05)	-10.2%	4.25**	1.17
General words ( <i>n</i> = 60)	-.60**	0.470 (0.04)	0.432 (0.05)	-8.1%	3.39**	0.91
Bird names ( <i>n</i> = 34)	-.62**	0.041 (0.01)	0.029 (0.02)	-27.4%	2.81**	0.79
Tree names ( <i>n</i> = 37)	.17	0.006 (0.01)	0.006 (0.01)	-2.6%	0.11	0.03
Flower names ( <i>n</i> = 55)	-.10	0.025 (0.01)	0.023 (0.01)	-10.2%	1.02	0.25
<b>Non-Documentaries (<i>n</i> = 224,765)</b>						
All words ( <i>N</i> = 186)	-0.67**	0.509 (0.04)	0.464 (0.06)	-8.8%	3.92**	0.91
General words ( <i>n</i> = 60)	-0.57**	0.435 (0.04)	0.405 (0.05)	-6.8%	2.49*	0.68
Bird names ( <i>n</i> = 34)	-0.58**	0.042 (0.01)	0.030 (0.02)	-27.5%	2.80**	0.77
Tree names ( <i>n</i> = 37)	0.02	0.006 (0.01)	0.004 (0.01)	-18.9%	0.71	0.17
Flower names ( <i>n</i> = 55)	-0.03	0.027 (0.01)	0.023 (0.01)	-13.5%	1.44	0.36
<b>Documentaries (<i>n</i> = 49,246)</b>						
All words ( <i>N</i> = 186)	-.73**	1.175 (0.32)	0.666 (0.20)	-43.3%	6.68**	1.89
General words ( <i>n</i> = 60)	-.70**	1.109 (0.34)	0.620 (0.21)	-44.1%	6.11**	1.74
Bird names ( <i>n</i> = 34)	-.04	0.018 (0.02)	0.018 (0.02)	0.2%	-0.008	~0
Tree names ( <i>n</i> = 37)	-.11	0.015 (0.04)	0.009 (0.01)	-41.5%	0.71	0.22
Flower names ( <i>n</i> = 55)	-.23*	0.032 (0.04)	0.020 (0.03)	-38.9%	1.23	0.35

\* $p < .05$ . \*\* $p < .01$ .

The ratio of nature-related words was not significantly associated with the year of origin for the period before 1950,  $r(18) = -.36$ ,  $p = .12$ . In contrast, this association was negative for the post-1950 period,  $r(63) = -.67$ ,  $p < .0001$ . These two correlation coefficients are significantly different from each other ( $z_{diff} = 4.34$ ,  $p < .0001$ ). A comparison of the averages before and after 1950 shows the magnitude of the drop to be 10.2% for the whole set of words ( $t = 4.25$ ,  $p < .0001$ ; see Table 4).

As before, we obtained patterns for words related to the human-made environment to assess the uniqueness of the pattern for nature-related words. Over the entire period, there was no relationship between year of origin and the ratio of words related to the human-made environment,  $r(83) = -.03$ ,  $p = .79$ . For the pre-1950 period, the correlation is significantly negative,  $r(18) = -.59$ ,  $p = .006$ , and for the post-1950 period, it is significantly positive,  $r(63) = .33$ ,  $p = .007$ . This is further evidence that nature-related words present a special case and do not reflect a general pattern applicable to words related to human environments.

To test the generalizability of findings across different genres of films, we analyzed nondocumentary and documentary titles separately. Both sets followed a pattern of decline over the entire period. The correlation of appearance ratio with the year of origin was  $-.67$  ( $p < .0001$ ) for nondocumentary titles and  $-.73$  ( $p < .0001$ ) for documentary titles. For nondocumentary titles, we again found

that the pattern of decline was more pronounced after 1950:  $r_{pre-1950}(18) = -.23$ ,  $ns$ , versus  $r_{post-1950}(63) = -.70$ ,  $p < .0001$ ;  $z_{diff} = 2.34$ ,  $p = .02$ . Documentaries, on the other hand, showed a similar pattern of decline before and after 1950:  $r_{pre-1950}(18) = -.50$ ,  $p = .02$ , versus  $r_{post-1950}(63) = -.54$ ,  $p < .0001$ ;  $z_{diff} = 0.17$ ,  $ns$ . For documentaries, the magnitude of the decline from pre-1950 to post-1950 was greater than that for nondocumentary films. For nondocumentary films, the drop in average ratios from before 1950 to after is 8.8% ( $t = 3.92$ ,  $p < .0001$ ), and for documentary films, it is 43.3% ( $t = 6.68$ ,  $p < .0001$ ).

## Discussion

Across three genres of cultural production, we have found converging evidence that the space taken by nature has been dwindling in the collective imagination and cultural conversation after the 1950s. Base rates of nature-related words vary across genres, as does the magnitude of change over time. Yet, the overall trend is clear and consistent: Nature features significantly less in English popular culture today than it did in the first half of the 20th century.

Culture is constantly branching out with new knowledge, artifacts, and activities. As a result, new words are continuously added to language, driving down the relative frequencies of longstanding words. Some of the decline we have observed likely owes to this dynamic. At

the same time, this dynamic cannot fully explain the declining relative frequencies of nature-related words, as we did not find a parallel pattern for words related to the human-made environment. In the post-1950 period, when use of nature-related words exhibited the strongest declines, words related to the human-built environment failed to exhibit a consistent pattern: They showed a significantly positive trend in works of fiction and movie storylines, and a marginally significant negative trend in song lyrics. The usage pattern of nature-related words thus presents a unique case.

If the identified decline of nature reflects a growing disconnection from nature, as we argue it does, a critical question concerns the reasons driving this change. Disconnection from nature is often attributed to two socioeconomic forces. The first is urbanization, which swallows up natural areas and cuts people off from natural surroundings. Were urbanization a major factor driving the discontinuous change around 1950 in the references to nature, we would expect to see an abrupt change in urbanization rates either in mid-century when artists were creating their works or around 1920–1930 when they were children. Neither of these predictions is borne out by the data. The growth rate of the U.S. urban population was steady between 1840 and 1960 and did not suddenly accelerate at any point in the beginning or middle of the 20th century (U.S. Census Bureau, 2004). Hence, if urbanization is a factor in explaining the observed pattern, it is unlikely to be the only or dominant one.

The second proposed explanation for the growing human-nature disconnection is technological change and particularly the growth in indoors and virtual recreation options (Pergams & Zaradic, 2006). Our findings are consistent with this proposition: The 1950s saw the rapid rise of television as the most popular medium of entertainment. Video gaming technologies first appeared in the 1970s and have since been a popular pastime, while the Internet is claiming evermore leisure time since the late 1990s. These technologies may well have been substituted for nature as a source of joy, recreation, and entertainment. It should be noted however, that the observed pattern does not rule out the influence of any other social dynamics that have played out since mid-century. The 1950s in the U.S. witnessed significant societal change, including growing affluence, migration to the suburbs, and rising consumerism aided by television advertising. Any of these factors, or a combination of them, may also have contributed to the patterns observed.

Overall, our findings suggest that after the 1950s, nature has become a less salient aspect of the world for the cultural community that created and consumed the studied products. This decline in the cultural attention to nature does not necessarily mean that people care less

about nature today than they did before. On the contrary, it is possible that care and concern for nature has increased over the period investigated, as pressing issues such as ozone layer depletion and global warming have made plain the fragility of nature.

The question of whether people “care” less about nature now is only one of the many questions about long-term changes in the human–nature relationship that our data cannot address: Do people conceive of nature in more utilitarian terms today than before, and less in aesthetic or spiritual terms? Do they see nature less as something to experience and more as something to consume or control? Do they have more or less reverence for nature than before and are they more or less apprehensive about it? And what do these different attitudes toward nature imply for conservation efforts and overall human well-being? A fuller understanding of the human connection to nature requires answers to these multifaceted questions.

Our studies were limited to cultural works in English and we do not know whether the findings would also apply to other linguistic communities. In addition to addressing the question of generalizability, studies of cultural products in different languages also would help identify mechanisms of change. Chronological differences in critical societal transitions across linguistic communities may offer insight into the factors that drive people away from nature.

## Conclusion

The pattern we documented is disconcerting in light of the strong evidence documenting the positive effects of contact with nature. To the extent that the disappearance of nature vocabulary from cultural conversation reflects an actual distancing from nature, the findings suggest unrealized gains to human health and well-being, as well as lost opportunities to nurture pro-environmental attitudes and stewardship behaviors.

There is another reason why these findings are of concern. Cultural products not only reflect the prevailing culture, they also shape it. Books, songs, and films are agents of socialization that help people to form, maintain, and reinforce particular worldviews. The flagging cultural attention to nature means a muting of the message that nature is worth paying attention to and talking about. It also means a loss of opportunities to awaken curiosity, appreciation, and awe for nature.

The loss of physical contact with nature, combined with a parallel loss of symbolic contact through cultural products, may set in motion a negative feedback loop, resulting in diminishing levels of interest in and appreciation for nature. In this light, our findings do not look auspicious. We hope that an awareness of the existing

trends will be instrumental in instigating cultural leadership to reverse them.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

### Supplemental Material

Additional supporting information may be found online.

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