



# Cues to care: future directions for ecological landscapes

Mark Hostetler<sup>1</sup>

© Springer Science+Business Media, LLC, part of Springer Nature 2020

## Abstract

The design of urban yards is key to reducing natural resource consumption in cities. However, going from turf lawns and ornamental plants to more native vegetation with structural complexity is contingent on public acceptance. Addressing social/cultural values is important and landscape designers frequently point to the need for yards to be designed with human intent, or ‘cues to care’. Cues to care studies have explored what kinds of designs and maintenance practices indicate that a landscape meets cultural expectations of standards for maintenance. The intent is to create more ecological landscapes, but research on cues to care has been sparse and results are often misinterpreted. In this perspective essay, I review past empirical studies in the U.S. and Canada, discuss the evolution of cues to care concept, and provide future synergies between landscapes that are aesthetically appealing and provide ecological benefit.

**Keywords** Cues to care · Biodiversity conservation · Urban ecology · Landscape design, ecological landscapes

## Introduction

### Urban yards: appearance and impacts

Homeowner preferences significantly drive the structure and plant composition of residential landscapes. For example, New York City tree canopy cover in private yards was primarily related to norms and styles perceived to be within a homeowner’s social group (Grove et al. 2014). In the United States and Canada, urban yards are traditionally dominated by turf grass and ornamental shrubs and viewed as part of the American dream (Dorsey 2009); urban yards across U.S. cities showed evidence of homogenization of both composition and structure (Pearse et al. 2018). Yards in different regions are similar and do not reflect the local diversity of native plants and animals.

From Ian McHarg’s *Design with Nature* (McHarg 1969), along with the Environmental Movement of the 1960s, citizens and scientists raised questions about the value of landscapes serving primarily aesthetic concerns (Alofsin 2002). Landscape designers began to question the ecological impact

of manicured lawns, ornamental and exotic tree and shrub species, and plantings that required irrigation and management regimes, including the use of fertilizers and pesticides (Venhaus 2012). Urbanization and expansion of agricultural landscapes have increased the consumption of natural resources and imposed significant impacts on natural environments (UNEP 2011). In particular, urban areas have become a significant factor in the degradation of local and regional environments (Platt et al. 1994; Hostetler 2012). Conventional landscaping approaches often require the use of pesticides, fertilizers, and herbicides to keep up appearances and maintain acceptable standards of care. The overuse of fertilizers impact rivers, streams, and lakes by raising the levels of nitrates and phosphates – ultimately causing algal blooms (Lin et al. 2008), and resulting in fish kills, coastal dead zones (Diaz and Rosenberg 2008), and the spread of invasive exotic plants (Sutton et al. 1992). With regard to climate change, the volume of CO<sub>2</sub> gases generated in maintaining traditional turf grass landscapes exceeds the contribution of turf grass made through carbon sequestration (Townsend-Small and Czimczik 2010).

However, ecological landscaping (e.g., yards that employ less turf grass and more native tree and shrub species) are often seen as wild or untamed and in urban settings, this wild, untamed nature is regarded as a lack of responsibility or a lack of care and sometimes even safety (Nassauer 1988, 1993; Yang et al. 2013). Changing public perception, attitudes and opinions is no easy task. Long-held gardening traditions and a preference for yards that have the appearance of human

---

✉ Mark Hostetler  
hostetm@ufl.edu

<sup>1</sup> Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA

control over nature are deeply rooted. Furthermore, North Americans have become accustomed to expecting evident maintenance as an indication of responsibility and care (Nassauer 1988; Sutton et al. 1992). Within this context, how likely is it that people would accept landscape designs that position ecological benefit with aesthetic objectives?

### Ecological landscape design and cues to care

In response to impacts that stem from the development and maintenance of urban and rural landscapes, some within landscape design disciplines have been moving towards more sustainable design practices that minimize impacts on the natural environment (Calkins 2011; Venhaus 2012). While many terms are used to describe these practices, I will use the term ‘ecological landscaping.’ Ecological landscaping, as I define it here, is a holistic approach of yard design and management practices that reduce the consumption of water and energy, reduce pollutants in the air and water, and provide habitat for native plants and animals. Ecological landscaping can have many synergistic social, economic, and environmental benefits. For example, conservation of native trees for wildlife habitat can also provide shading for homes to reduce sun loading and energy consumption (Huang et al. 1987). By creating ecological landscaping, with reduced areas of turf grass, higher numbers of native plants, and the reduced need for maintenance practices such as irrigation, mowing, and use of fertilizer and pesticides, these landscapes consume fewer natural resources and have less impacts on surrounding natural landscapes (Hostetler 2012; Hostetler and Reed 2014).

Reducing the extent of yards covered in turf grass and planting more native species of shrubs and groundcovers provides significant increases in habitat for native and migrant bird species. Previous studies show that the diversity of native birds in urban environments increases with greater native vegetation and tree canopy cover (Hostetler and Holling 2000; MacGregor-Fors 2008). In addition, butterflies (Collinge et al. 2003) and the diversity of native bees increases when more native plants are used in landscaped urban environments (McIntyre and Hostetler 2001). Increases in the use of native plants, reduction in the areas of turf grass lawns, and the conservation of topsoil during landscape and building construction reduces the need for irrigation, fertilizers, and pesticides required to maintain landscapes (Reid and Oki 2008). Less impervious surfaces and more trees intercepting rainfall means that less stormwater runoff and fewer pollutants are carried to nearby wetlands (USEPA 2009).

Landscape scholars have argued for ecological functionality in design but have warned that compromising commonly-held notions of landscape attractiveness would likely result in public rejection of the approach (Nassauer 1988, 1993). Indeed, surveys have indicated that the public prefers non-native plantings in urban areas (Hoyle et al.

2017). The term ‘cues to care’ was coined by Nassauer (1995) in a paper titled *Messy Ecosystems, Orderly Frames* and is a phrase used to describe actions undertaken by humans that indicate a landscape is well cared for and meets cultural expectations of standards for maintenance. According to this concept, there is a common expectation in societies that landscapes will be looked after, managed, and maintained to acceptable standards. This assumption can be summed up, as Nassauer (1988) suggests, with the question ‘Does it look like they’re taking care of it?’ But judging the care of a landscape by its appearances can present some problems, particularly when the more commonly recognized standards of care are some of the most damaging and harmful designs to the natural environment.

Joan Nassauer proposed the concept of ‘cues to care’, and I thought it would be interesting and helpful to look at studies that tested perceptions and attitudes associated with this ‘cues to care’ perspective. This is an important concept to evaluate and measure because practitioners are using ‘cues to care’ studies to design yards across America (personal observation but also see Sustainable Sites Initiative, <http://www.sustainablesites.org/>). Further, a case study found that when landscape designers and the American Society of Landscape Architecture members were surveyed about using native plants and more natural landscaping, they indicate that they felt limited in their use due to a perceived lack of receptivity of clients (Hooper et al. 2008). For this perspectives essay, my two objectives are: 1) to review the methodologies and findings of cues to care studies that empirically measure landscape preferences in United States and Canada; and 2) to explore future directions for cues to care studies and ways to incorporate ecological practices with landscape appearance in North American landscapes.

### Reviews of cues to care studies

While preferences on yard appearance derive from cultural perspectives and social values, approaches in the design, construction and management of yards can achieve a balance between the demands of ecological function and appearance expectations. Whereas these two values have traditionally been framed as odds with one another, in fact, past cues to care studies suggest a possible level of tolerance for ecologically designed landscapes. In this section, I discuss the following questions. Have the previously-identified cues been measured appropriately and do they represent public perception and preferences? Are there other landscaping cues to care that have been overlooked or warrant consideration more than two decades after the first cues to care were identified? With these questions in mind, I discuss some of the previous cues to care studies. The below studies were found in a Web of Science search using key words ‘yard preference’ ‘homeowner or

residents preference’ + ‘landscapes’; ‘ecological design’; ‘cues to care’; and Nassauer J.’ I reviewed manuscripts that presented a range of landscape designs and landscaping cues to study participants (e.g. trimmed hedges and mowed lawns to more natural vegetation). I only looked for studies that showed participants various landscape designs and cues and analyzed their different responses; from the systematic review, I identified four peer-reviewed studies discussed below.

One early urban study looked at aesthetics and public opinion and perception of varying urban yard design (Nassauer 1993). Researchers surveyed homeowner attitudes towards seven different types of suburban residential front yard landscape designs, ranging from highly-manicured landscapes with mowed lawn and ornamental trees and shrubs to more ecologically complex landscapes built with greater numbers of native plants (Table 1). The study was conducted in Minneapolis-St. Paul and included 167 homeowners from several suburban neighborhoods with moderate to high household incomes. Participants responded to visual preference surveys administered at one of eight group events. Opinions collected from this survey suggested that participants perceived the more native landscapes (with only 25% mowed lawn) as messy and unattractive. Participants responded positively to manicured ‘cues’ in the presented landscapes, such as mowed lawn and trimmed shrubs. The researcher’s conclusions from this study suggest that in order for more ecological approaches to be undertaken in the design and maintenance of residential landscapes, particular attention must be paid to the identified ‘cues to care.’ The cues to care that were identified by this study included: the extent of mowed lawn, shrubs showing evidence of regular pruning and shaping, and trimmed and maintained border and edge plantings. As Nassauer (1993) noted, ‘As a general guideline, these mown areas should cover at least half the front yard.’

Several problems are associated with the design and interpretation of the study. First, it was a nonrandom sample as people were invited to group events and no effort was made to

make the study a random sample (Sokal and Rohlf 1995). This nonrandom sample means that the results do not reflect the average opinion of homeowners in these Minneapolis-St. Paul neighborhoods. Second, there was no attempt to address non-response bias (i.e., what are the opinions of those that refused to do the study? Lindner et al. 2001) Participants who were invited but did not attend these group events may have had different responses to the administered surveys. Therefore, responses do not reflect the average opinions of people in these neighborhoods. Third, this study included only homeowners from neighborhoods in Minneapolis-St. Paul, and the results cannot be interpreted as a broader aesthetic preference across other cities. The survey results reflect the opinions of people in these particular neighborhoods in this one city. Fourth, the sample of homeowners were drawn from neighborhoods with landscapes that had highly manicured lawns; therefore, the norm is biased towards this particular type of landscape. Subjective norms have a huge influence on attitudes and behaviors (Cialdini 1996) and it was found to influence landscaping choices in city neighborhoods (Nassauer et al. 2009; Larsen and Harlan 2006; Sisser et al. 2016). In summary, this study may or may not reflect the landscaping preferences of homeowners in these neighborhoods and one cannot interpret these results to suggest that residential property owners would only accept ecologically designed landscaping if such landscaping contained, for example, at least 50% mowed lawn. In reality, this may only be the case for these neighborhoods in Minneapolis-St. Paul and does not represent general preferences.

Another study considered how participants perceive rural landscapes in two townships of Olmsted County, Minnesota (Nassauer 1988). While the sections within two townships had a stratified-random sampling strategy, the selection of interviewed participants was not random ( $n = 48$ ) and non-response bias was not addressed, i.e., 64% agreed to be interviewed and there was no accountability for the 36% that did not respond (Lindner et al. 2001). Participants reviewed

**Table 1** Seven images of a front yard were presented to homeowners in Minneapolis-Saint Paul metropolitan area. Each image varied with vernacular cues to care, such as amount of mowed lawn, foundation plantings, and colorfulness of herbaceous cover

Front yard image	Landscape description
1 Conventional landscape	Turf lawn with ornamental plants
2 Conventional lawn that is not maintained	Tall, weedy grass with untidy ornamental plants
3 Conventional lawn with native trees and shrubs	Native trees and shrubs were added to the conventional, maintained landscape
4 50% less lawn with prairie	Replaced 50% of the front lawn with prairie plants, still contained native trees
5 75% less lawn with prairie	Replaced 75% of the front lawn with prairie plants, still contained native trees
6 50% less lawn with oak shrubs	Replaced 50% of the front lawn with oak shrubs, still contained native trees
7 75% less lawn with prairie/shrubs	Replaced 75% of the front lawn with prairie plants and shrubs, still contained native trees

aerial maps and rated agricultural landscapes as being either attractive or unattractive. For both farmers and non-farmers, landscape attractiveness was high with aesthetic features classified as naturalness, neatness, and conservation. On average, farmers looked for neat farm management (e.g., rows of crops) whereas non-farmers tended to prefer naturalness (e.g., scenic areas with trees and crops). Overall, the author concluded that rural Minnesotans like ‘neatness’ or some signs of care. I note here that non-farmers liked scenic wooded areas along with crops, suggesting that ecological concerns could be integrated with row crops. However, the study was not a random sample and non-response bias was not addressed; thus the study may not fully reflect how rural people in these two townships view the aesthetics of rural areas.

In a more recent survey of residential homeowners regarding wooded areas in suburban neighborhoods, Visscher et al. (2012) asked participants about their preferences for wooded residential landscapes. In this study, participants were randomly selected from a 10-county area around Detroit. Out of 1179 mailed requests to participate in the survey, only 126 responded (10.7% response rate). Participants who completed the survey were older residents typically representing households with children. To understand woodland preferences in yards, participants were shown images of front and backyards with varying levels of woodlands. Front yard images ranged from conventional (mainly mowed turfgrass) to 50% native and 75% native; backyard images contained various levels of wooded areas and different structures underneath the canopies, i.e., native woodlands with and without turfgrass beneath. Results indicated that property owners seemed to prefer mature trees with turf-dominated back and front yards, and neatness. While preferences varied with some homeowners preferring the entire yard to be wooded, the authors pointed out that most homeowners preferred wooded yards exhibiting cues to care, such as mature trees in the front yard with low herbaceous understory, prominent mowing, and crisp edges around planting beds.

This study did have a random sample of a much larger residential area and held the potential that the surveyed participants represented local preferences. The authors noted that the respondent population was one of older homeowners with children. However, several methodological issues arise that make interpretations difficult. First, these participants were most likely drawn from conventional neighborhoods that typically have large proportions of mowed lawn. The study did not give information about typical yards, but I suspect that these areas around Detroit were studied before (Nassauer 1993). Thus, the subjective norm for the community is mowed lawns and general levels of care with trimmed bushes and ornamentals. The interpretation should be that people within a community with lots of lawn tend to favor such cues to care and one cannot generalize for other neighborhoods around the country. This clarification is important but it was not explicitly

discussed by the study’s authors. Notably, many respondents scored fairly high for a *fitting in the neighborhood* scale, suggesting that the neighborhood norm influences preferences for mowed lawns because they wanted to fit into neighborhood norms. In a related analysis on Central Michigan homes near Detroit, researchers found that neighborhood norms have a strong influence on landscaping preferences (Nassauer et al. 2009). Lastly, the response rate in the Visscher et al. (2012) study was very low (10.7%) and non-response bias was not addressed. Therefore, readers do not really know what the dominant landscape preferences are for these neighborhoods in southeast Michigan.

On a single property, Hands and Brown (2002) gathered the opinions of landscape attractiveness of a 200-acre restoration project taken place on 800-acre industrial site near Niagara Falls, Canada. In this study, employees of the company housed on this restored site were presented with visual simulations of ‘apparent human intent’ and color (in terms of flowering plants) for two restoration project stages: establishment and maturity. Human intent was represented by various non-vegetative manipulations such as constructed bird boxes, signage, clustered landscaping and the addition of large rocks. Of 101 employees, 60 completed the surveys and ranked their visual preferences on a 7-point likert-type scale. The results indicated a correlation between both human intent and color and preference for the restored landscape. In this case study, the implications for design suggested that adding vernacular cues to care (such as the addition of color) and human modifications (such as signs and bird boxes) would make restored landscapes more acceptable to the public. This study is not generalizable beyond the company and the site studied, but it does point to the fact that cues of human intention help promote the attractiveness of a landscape being restored and perhaps acceptance by nearby constituents. However, neither the amount nor types of human intention could be quantified as only a few human practices were presented (presence of one sign and one bird box in a photo of a portion of the property). This begs the question about the quantity and types of cues needed to gain peoples’ acceptance of the different stages of restoration. For example, is only one sign and one bird box enough to gain acceptance?

Overall, I found only four studies in North America that empirically tried to determine which cues to care were important for residents and at what levels. However, the certain papers that reference these studies were heavily cited (e.g., Nassauer 1995 was cited 846 times). Knowing the appropriate cues to care could help landscape designers and managers to adopt more ecologically oriented designs and maintenance programs with higher levels of public acceptance (Asakawa et al. 2004; Gobster et al. 2007; Nassauer et al. 2009). While I agree with this proposition, I believe that the types and degree of cues to care (e.g., Table 1) have not been firmly established for a wide range of residential neighborhoods found

throughout the U.S. and Canada. Although it is important to address cues to care if ecological landscaping is to be incorporated into yards, research to date is limited to only a few cities in North America. From the cues to care studies undertaken to date, the danger is that urban decision makers may believe the results from these limited studies represent the cultural perceptions and social values for urban communities. These past studies may be taken as prescriptions for specific cues to care for all types of cities around the world. In fact, the results of these cues to care studies do not represent preferred yard designs and management for all communities. At best, they apply only to those communities studied.

Citing these relatively few studies, landscape designers, realtors, and developers may be using this research to rationalize specific landscape designs that address cues to care. For example, one suggestion is that parcels need at least 50% mowed lawn in order for a landscape design to be acceptable. This may be the case for a few people and in certain situations, but is it the case for every homebuyer and neighborhood? The landscaping preferences of a homebuyer coming from an older residential neighborhood with very little mowed lawn may have very different landscape preferences. These homebuyers might accept yards with little to no mowed lawns. Therefore, one should not take the suggestions that are offered from these cues to care studies as universal prescriptions. Property owners of Minneapolis-St. Paul may have very different landscape aesthetic preferences than property owners in Seattle and Miami. More research is needed to determine the landscaping preferences across a range of cultures and norms within neighborhoods. In the next section, I discuss future directions to determine which cues are important and how aesthetics and ecological functionality can be addressed in urban landscapes.

### Future research directions and synergistic strategies

Designers and maintenance professionals need to blend aesthetics and ecological functionality if more sustainable landscapes are to be created for urban yards. Academics in the fields of ecology and landscape design and management need well-designed studies to inform practitioners about potential challenges and solutions. In my experiences, many landscape design professionals refer to these cues to care studies as representing the dominant viewpoint by people across North America. Practitioners believe that homeowners would only accept a landscape with levels of care that were presented in these studies. In this section I will discuss 1) methodologies for future studies to determine specific cues to care; and 2) future strategies that explore the merging of ecological landscaping with cues to care.

### Future study methodologies

Cues to care is a concept that recognizes cultural perspectives and social values when incorporating ecological approaches in the design and maintenance practices of yards. In the following discussion, I focus on residential landscapes but each of the points proposed could also have relevance to urban greenways and agricultural landscapes.

Decision makers should be cognizant of the public's landscape aesthetic preferences and levels of acceptance if they hope to promote and adopt more ecological approaches in landscape design and maintenance practice and approaches. Therefore, it is important to know which cues to care are necessary for ecologically-designed landscapes to be acceptable by the public. To date, this has not been well researched and I suggest specific methodological approaches and offer some caveats about interpreting any such study.

1. For all cues to care studies, the neighborhood or landscape features represented by surveyed homeowners need to be well measured and described to determine the landscaping norm for the community. A combination of aerial maps and random sampling points can help characterize landscaping percentages throughout a neighborhood. This will set the boundaries for interpreting the results of surveys of preferred design choices of study participants. For example, if hypothetically 80% of yards in a neighborhood have 70% or more of their landscape areas as mowed lawns, the responses to visual preferences by homeowners would be couched in these terms. The norm for the community is mowed lawn and may be reflected in average aesthetic preferences. Visual preferences of this hypothetical community could only be generalized to other similar communities.
2. There needs to be a true random or random stratified sample. Several of the previous cues to care visual preference studies were not random samples. For example, inviting property owners to a group and then conducting preference surveys is not a random sample. It could be that the people that showed up are not representative of the neighborhood in question. These types of studies may not represent the preferences by residents in the neighborhood. Even if the sample is truly random, results cannot be extrapolated to other neighborhoods across the country, unless these neighborhoods have similar demographics and landscaping features. Many techniques are available to sample a population randomly (Sokal and Rohlf 1995).
3. There is a need to account for nonresponse bias in visual preference studies and this was not done in previous cues to care studies. A low response rate is typical in survey studies but there are several techniques to improve response rate and to account for nonresponse bias (Dillman 2000; Lindner et al. 2001). First, multiple emails and

mailed surveys should be performed to increase response rate. Typically, phone calls are utilized to contact people that have not responded. Additionally, small rewards could be implemented to improve response rate (e.g., gift certificates). Administering survey questions through a focus group will help determine misleading or confusing questions and aid in interpreting what participants are thinking when they answer specific questions. Even when these measures are implemented, response rates could still be low and it is necessary to reach out and ascertain typical responses of nonresponders. One way to do this is to compare preferences of early versus late responders. This can be used as a proxy to determine if there are large nonresponse biases. If no differences occur in early versus late responders, one can be more confident that the actual respondents from the sampled population represents the population at large (Dillman 2000). Another technique is to target nonresponders with concentrated follow-up effort to see if they would participate in the study. Then, one would compare these average responses to the first responders to determine any biases.

4. If the above three suggestions are implemented, the results are more likely to reflect the average preference for the neighborhood(s) being studied; however, it does not reflect preferences for other neighborhoods unless they contain the same demographics and yard designs, reflecting the norm of landscaping preferences for the community. Results should be discussed in these terms and any prescriptions of cues to care must be characterized as only pertinent to people that are of similar demographics and living in similar neighborhoods. This, I think is critical as from personal conversations with the built environment community, practitioners have used these cues to care studies to put forth the argument that specific landscaping cues, such as mowed lawns, are essential in order to create acceptable landscaping. This may be false and/or only relevant to communities with large expanses of manicured lawns. Care should be taken when discussing the broader applicability of visual preference studies, particularly when landscaping prescriptions are suggested as a minimum to gain acceptance within a community. Designing with cues to care can be included into a development to promote healthy ecosystems, such as the Sustainable Sites Initiative that promotes sustainable design and management recommendations (<http://www.sustainablesites.org/>).

### Merging aesthetics and ecological functionality

As discussed, I think that subjective norms (Cialdini 1996), such as the dominant landscaping design in a residential

community, probably shapes what is acceptable or not in terms of unconventional residential landscape design and maintenance. Coming from or growing up in a neighborhood with lots of manicured lawn and ornamental trees and shrubs compared to more natural landscaping has probably formed one's own residential landscape preferences (Nassauer et al. 2009). In addition to the influence of the types of landscapes people are exposed to in their current and early-life neighborhoods, landscape preferences may also be shaped by human evolution. In a Nature versus Nurture debate, the Nature argument suggests that the humans may have a preference for savannah-type landscapes because humans evolved in the Africa Rift Valley (Lewis 1996). Scattered trees with mowed lawns reflect the savannah landscape and may be an innate and hardwired part of the human psyche. This predisposition could be a factor in shaping our modern day landscaping preferences. However, most human behaviors are a product of both nature and nurture and our current environment and context is likely to hold great influence on our preferences and desires. Further, developer decisions have created the subjective norm for the community, making it difficult for people to implement alternative landscaping. If preferences and acceptance of landscape types is a product of our upbringing and context and shaped by cultural perspective and social values, how malleable are these preferences and ranges of acceptance?

While it makes intuitive sense, that acceptable yard designs are shaped by cultural/social values and how humans evolved, the question is - are these landscaping preferences malleable? For example, if the goal is to provide more ecological functionality within a subdivision design, perhaps it is better to begin with minimal turf grass and a predominance of native tree and shrub species. If developers plan and design new developments with just 10% turf grass for each lot and 80% conserved tree canopy cover, then the landscaping norm for these communities may be more accepting of an ecological design. Attitude theory has indicated that people's values and preferences are hard to change (Heberlein 2012). However, it has been shown that landscaping preferences can be changed through education; Peterson et al. (2012) demonstrated that homeowners would adopt more natural yards after being exposed to some education materials about environmental impacts. Cues to care may still be relevant, but perhaps with environmental education, conventional visual cues may become less important of a factor to landscaping preferences. Even with attitudinal shifts caused by environmental education, other factors such as subjective norms and regulations (Sisser et al. 2016; Wheeler et al. 2020) can prevent behavioral changes (e.g., theory of planned behavior, Leeuw et al. 2015).

Several green communities in the U.S., known as conservation developments or conservation subdivisions, have employed ecological landscaping and management practices

in their early development stages and have still been successful in selling and maintaining the value of the homes in these neighborhoods. Prairie Crossing, near Chicago Illinois, required individual lots to maintain a minimum of 30% native prairie plants in their landscape treatments (Watson 2016). Common areas were planted with primarily native species of trees, grasses, and shrubs and lot owners were supportive of prescribed burns in the community's shared landscape areas; homeowners even conducted prescribed burns on their individual lots (Watson 2016). In Gainesville, Florida, the Madera subdivision was built with the majority of lots containing no irrigated lawn areas and a high percentage of existing tree canopy was conserved throughout. Even the model home carried these landscaping standards. In a 2004 economic analysis, the construction of ecological landscaping in Madera cost less (on average \$1476 less) than conventional landscape approaches (G. Acomb, University of Florida, unpublished data). Most savings came from reduced lot clearing, stormwater infrastructure savings, and reductions in turf grass application. As lots have been sold at Madera over the past 15 years, property owners have maintained the ecological landscaping approach of their lots with minimal or no turf grass lawns and maintaining the native tree and shrub cover that provides valuable habitat for local wildlife species.

Arguments could be made that green communities are a small subset of homebuyers; they were already environmentalists or 'green-minded' and this type of development would not work for most homebuyers. However, several studies that compare conservation to conventional development homebuyer environmental attitudes, knowledge, and behaviors demonstrate little to no differences between these two groups. Comparing two pairs of conservation to conventional developments in Florida, results indicated no difference in homebuyer preferences for green landscaping practices such as indoor air quality, open green spaces nearby, energy efficiency, energy-efficient appliances (Noiseux and Hostetler 2008). Using these same communities, researchers also found no difference in environmental attitudes, knowledge, and behaviors (Hostetler and Noiseux 2010). In another comparative study, homeowners did not differ in environmental attitudes, knowledge, and behaviors among a conservation development, an older residential community, and a random draw of conventional developments in Gainesville, Florida. Interestingly, the conservation development actually had lower environmental scores (Youngentob and Hostetler 2005). These studies suggest that a large population of homebuyers might choose a more ecologically designed neighborhood if given the option. Homebuyers and property owners may have a more expansive view of ecological design than what real estate developers, landscape designers and lawn maintenance consultants might otherwise believe.

Nevertheless, context is everything. What reveals itself as a preference in one region might be very different in another and

every community and every neighborhood may hold different opinions about landscape appearance, cues to care and resistance to ecological design. Differences in taste between northern and southern American urban areas or European and North American communities, and even the preferences of property owners in newer and older established neighborhoods are all important considerations.

## Conclusions

Overall, knowing the limitations and opportunities for the public to accept ecological landscapes is very important, and I think continued research in the realm of cues to care is needed. Research could be conducted to determine not only how variable cues to care are from one context to the next, but to better understand how subjective norms could be changed from raising awareness and creating working models of ecological landscapes. Such studies would result in more targeted solutions that allow for higher levels of acceptance of and even preference for ecological landscapes. Such studies would help us better understand how to raise awareness, educate and promote these practice approaches and directions and help us answer others questions such as: Would targeted marketing and educational and interpretive signage within neighborhoods change property owners' attitudes and behaviors? Is it possible to eliminate turf grass and irrigation and still have a desirable landscape? Can landscaped areas be more like 'controlled chaos' where semi-wild areas are bordered with trim borders of shrubs, landscape timber, or other materials? How do neighborhood subjective norms limit landscaping options and are these malleable?

Ultimately, the goal is to have both attractive and ecologically functioning human-dominated landscapes. In urban areas, residential landscapes have typically been dominated by ornamentals species and manicured lawns. The challenge of shifting landscape preferences remains but the use of cues to care is a potent and viable possibility for demonstrating caring in a new era of environmental awareness. Landscapes, even suburban residential landscapes, can account for a significant part of regional ecosystems. In an era in which DIY and home improvement concerns occupy such a significant part of our entertainment interest and cultural identity, the landscape design community are presented with an unusual opportunity to advocate on behalf of ecological function along with aesthetic and appearance concerns. With this new era, perhaps it is appropriate to suggest a new term that recognizes the synergies between form and function: *Eco-attractive Landscapes*. Eco-attractive landscapes incorporate ecological functionality into a design, they are visually pleasing, and the exhibit evidence of human intent and caring. Deep, holistic and creative thinking is required for landscapes that meet both ecological and attractive design goals. One such lot design in Madera, a 44-acre

development in Gainesville, Florida, reduced the amount of turfgrass, built a shared permeable pavement driveway, and created a natural rain garden in the front yard from conserved topography and native plants.

Given the variety of contexts in the United States, Canada, and around the world, the eco-attractive landscape would naturally take different forms depending on local ecological conditions and local societal norms. Patches of ecological landscaping, with complex vertical height structure, could be bordered with landscaping rocks, trimmed hedges, etc. (i.e., cues to care). These bordering features would indicate human intent while simultaneously providing a more chaotic, ecological landscape in the landscaped patch itself. Eco-attractive landscapes conjure a whole other creative endeavor, not just in how landscapes appear, but also in how they function ecologically. Ultimately, exploring peoples' preferences when incorporating more natural landscaping needs to be researched and such studies will lead to the reduction of environmental impacts and create landscapes that serves as a better host to wildlife and human kind alike.

**Acknowledgements** I would like to thank Kevin Thompson for initial comments. This work was supported by the USDA National Institute of Food and Agriculture, Renewable Resources Extension Act, UF/IFAS project 1000606.

## References

- Alofsin A (2002) The struggle for modernism: architecture, landscape architecture, and City planning at Harvard. W.W. Norton, New York
- Asakawa S, Yoshida K, Yabe K (2004) Perceptions of urban stream corridors within the greenway system of Sapporo, Japan. *Landsc Urban Plan* 68:167–182
- Calkins M (2011) *The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies and Best Practices for Sustainable Landscapes*. Wiley, Hoboken
- Cialdini RB (1996) Activating and aligning two kinds of norms in persuasive communications. *J Interpret Res* 1(1):3–10
- Collinge SK, Prudic KL, Oliver JC (2003) Effects of local habitat characteristics and landscape context on grassland butterfly diversity. *Conserv Biol* 17(1):178–187
- Diaz RJ, Rosenberg R (2008) Spreading dead zones and consequences for marine ecosystems. *Science* 321(5891):926–929
- Dillman DA (2000) *Mail and internet surveys: the tailored design method*, 2nd edn. New York, Wiley
- Dorsey JW (2009) Lawns as symbols of American values: is it time for a change? *Interdiscip Environ Rev* 11(1/2):1–19
- Gobster PH, Nassauer JI, Daniel TC, Fry G (2007) The shared landscape: what does aesthetics have to do with ecology? *Landsc Ecol* 22:959–972
- Grove JM, Locke DH, O'Neil-Dunne JPM (2014) An ecology of prestige in New York City: examining the relationships among population density, socio-economic status, group identity, and residential canopy cover. *Environ Manag* 54:402–419
- Hands DE, Brown RD (2002) Enhancing visual preference of ecological rehabilitation sites. *Landsc Urban Plan* 58:57–70
- Heberlein TA (2012) Navigating environmental attitudes. *Conserv Biol* 26(4):583–585. <https://doi.org/10.1111/j.1523-1739.2012.01892>
- Hooper VH, Endter-Wada J, Johnson CW (2008) Theory and practice related to native plants: a case study of Utah landscape professionals. *Landsc J* 27:1–08
- Hostetler M (2012) *The Green Leap: A primer for Conserving Biodiversity in Subdivision Development*. University of California Press, Berkeley
- Hostetler ME, Holling CS (2000) Detecting the scales at which birds respond to landscape structure in urban landscapes. *Urban Ecosyst* 4:25–54
- Hostetler ME, Noiseux K (2010) Are green residential developments attracting environmentally savvy homeowners? *Landsc Urban Plan* 94:234–243
- Hostetler M, Reed S (2014) Conservation development: designing and managing residential landscapes for wildlife. In: McCleery RA, Moorman CE, Peterson MN (eds) *Urban wildlife conservation*. Springer, New York, pp 279–302
- Hoyle H, Hitchmough JD, Jorgensen A (2017) Attractive, climate-adapted and sustainable? Public perception of non-native planting in the designed urban landscape. *Landsc Urban Plan* 164:49–63
- Huang YJ, Akbari H, Taha H, Rosenfeld AH (1987) The potential of vegetation in reducing summer cooling loads in residential buildings. *J Clim Appl Meteorol* 26(9):1103–1116
- Larsen L, Harlan SL (2006) Desert dreamscapes: residential landscape preference and behavior. *Landsc Urban Plan* 78:85–100. <https://doi.org/10.1016/j.landurbplan.2005.06.002>
- Leeuw A, Valois P, Ajzen I, Schmidt P (2015) Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: implications for educational interventions. *J Environ Psychol* 42:128–138
- Lewis CA (1996) *Green Nature/Human Nature: The Meaning of Plants in Our Lives*. University of Illinois Press, Champaign
- Lin YJ, He ZL, Yang YG, Stoffella PJ, Philips EJ, Powell CA (2008) Nitrogen versus phosphorus limitation of phytoplankton growth in ten Mile Creek, Florida, USA. *Hydrobiologia* 605:247–258
- Lindner JR, Murphy TH, Briers GE (2001) Handling nonresponse in social science research. *J Agric Educ* 42(4):43–53
- MacGregor-Fors I (2008) Relation between habitat attributes and bird richness in a Western Mexico suburb. *Landsc Urban Plan* 84(1):92–98
- McHarg IL (1969) *Design with Nature*. Doubleday/Natural History Press, New York
- McIntyre N, Hostetler ME (2001) Effects of urban land use on pollinator (Hymenoptera: Apodidea) communities in a desert Metropolis. *J Appl Theor Biol* 2:209–218
- Nassauer JI (1988) Landscape care: perceptions of local people in landscape ecology and sustainable development. *Landsc Land Use Plan* 8:27–41
- Nassauer JI (1993) Ecological function and the perception of suburban residential landscapes. In: Gobster PH (ed) *Managing Urban and High Use Recreation Settings*, General Technical Report. St. Paul, USDA Forest Service North Central Forest Exp. Station
- Nassauer JI (1995) Messy ecosystems, orderly frames. *Landsc J* 14(2):161–170
- Nassauer JI, Wang Z, Dayrell E (2009) What will the neighbors think? Cultural norms and ecological design. *Landsc Urban Plan* 92:282–292
- Noiseux K, Hostetler ME (2008) Eco-opportunity knocks: do homebuyers want green features in communities? *Environ Behav* 42(5):551–580
- Pearse WD, Cavender-Bares J, Hobbie SE, Avolio ML, Bettez N, Roy Chowdhury R, Darling LE, Groffman PM, Grove JM, Hall SJ, Heffernan JB, Learned J, Neill C, Nelson KC, Pataki DE, Ruddell BL, Steele MK, Trammell TLE (2018) Homogenization of plant



- diversity, composition, and structure in north American urban yards. *Ecosphere* 9(2):e02105. <https://doi.org/10.1002/ecs2.2105>
- Peterson MN, Thurmond B, Mchale M, Rodriguez S, Bondell HD, Cook M (2012) Predicting native plant landscaping preferences in urban areas. *Sustain Cities Soc* 5:70–76
- Platt RH, Rowntree RA, Muick PC (1994) *The Ecological City: Preserving and Restoring Urban Biodiversity*. The University of Massachusetts Press, Amherst
- Reid SK, Oki LR (2008) Field trials identify more native plants suited to urban landscaping. *Calif Agric* 62(3):97–104
- Sisser JM, Nelson KC, Larson KL, Ogden LA, Polsky C, Chowdhury RR (2016) Lawn enforcement: how municipal policies and neighborhood norms influence homeowner residential landscape management. *Landsc Urban Plan* 150:16–25
- Sokal RR, Rohlf FJ (1995) *Biometry: The Principles and Practice of Statistics in Biological Research*, 3rd edn. W.H. Freeman and Company, New York
- Sutton DL, Vann TK, Portier KM (1992) Growth of Dioecious and Monoecious Hydrilla from single tubers. *J Aquat Plant Manag* 30: 15–20
- Townsend-Small, A. and C.I. Czimczik. (2010). 'Carbon sequestration and greenhouse gas emissions in urban turf', *Geophys Res Lett* 37/2 <https://doi.org/10.1029/2009GL041675>
- U.S. Environmental Protection Agency (USEPA) (2009) Storm Water Phase II Final Rule: Construction Site Runoff Control Minimum Control Measure, Rep. No. EPA 833/F-00/008, Office of Water, Washington, D.C. USA
- United Nations Environment Programme (2011) *Decoupling natural resource use and environmental impacts from economic growth*. UNEP, Nairobi
- Venhaus H (2012) *Designing the Sustainable Site: Integrated Design Strategies for Small-scale Sites and Residential Landscapes*. Wiley, Hoboken
- Visscher RS, Nassauer JI, Marshall LL (2012) Homeowner preferences for wooded front yards and backyards: implications for carbon storage. *Landsc Urban Plan* 146:1–10
- Watson JS (2016) *Prairie crossing: creating an American conservation community*. University of Illinois Press, Chicago
- Wheeler MM, Larson KL, Andrade R (2020) Attitudinal and structural drivers of preferred versus actual residential landscapes in a Desert City. *Urban Ecosyst*:1–15. <https://doi.org/10.1007/s11252-020-00928-0>
- Yang B, Ming-Han L, Shujuan L (2013) Design-with-Nature for Multifunctional Landscapes: Environmental Benefits and Social Barriers in Community Development. *Int J Environ Res Public Health* 10(11):5433–5458. <https://doi.org/10.3390/ijerph10115433>
- Youngentob K, Hostetler ME (2005) Is a new urban development model building greener communities? *Environ Behav* 37:731–759