When Ecological Information Meets High Wildlife Value Orientations: Influencing Preferences of Nearby Residents for Urban Wetlands

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ABSTRACT

Preferences for landscapes are critical because they can drive landscape changes over time. The mediating role of wildlife value orientations in influencing preferences for urban wetlands through the provision of ecological information (based on insectivorous bats) was experimentally tested. Residents (N = 198) were asked about their preferences for wetlands, as depicted in 27 photographs. Half of the participants were provided with ecological information. Urban wetlands of high habitat quality for bats were preferred by both groups. There was a significant influence of ecological information on preference, although unexpectedly, this was on wetlands of low quality habitat; people who received ecological information had lower preferences for wetlands that provided lower quality habitat for bats. This influence was mediated by wildlife value orientations (wildlife rights and recreational wildlife experiences). Results suggest that preferences for landscapes can be influenced by providing information that is consistent with value orientations.

KEYWORDS

Biased assimilation; conservation; ecological aesthetics; environmental value orientations; landscape preference

Introduction

Landscape preferences are critical in human-dominated areas, as they partially drive landscape change and the ongoing sustainability of landscapes by influencing planning and management (Gobster, Nassauer, Daniel, & Fry, 2007). If a landscape elicits positive perceptions, people are more likely to accept management plans and actions (Nassauer, Kosek, & Corry, 2001). These areas are also more likely to be protected and maintained than landscapes that are perceived as ugly or ordinary, regardless of their ecological significance (Gobster et al., 2007; Nassauer, 1995). Despite the importance of considering public preferences for landscapes, the relationship between these preferences and ecological quality has received relatively little attention in urban and landscape planning research (Jankevica, 2012). This information is needed for improving the design of urban landscapes for people and wildlife. If designers and managers of urban landscapes have a greater understanding of the public’s landscape preferences and the characteristics that foster biodiversity, they can align design and management to meet both aims. Alternatively, these stakeholders may be able to influence public preferences so they align more strongly with ecological necessities.

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This study explored resident preferences for urban wetlands and whether the provision of ecological information can influence these preferences. The theories of ecological aesthetics (Gobster, 1999) and biased assimilation (Lord, Ross, & Lepper, 1979) provide some guidance on this issue. The theory of ecological aesthetics argues that alignment between ecological and aesthetic management goals is possible if people see, understand, and experience a landscape using an “ecological aesthetic” mode rather than a “scenic aesthetic” one (Gobster, 1999). When using a scenic aesthetic mode, individuals enjoy the view of a landscape without regard to its ecological integrity. In contrast, when using an ecological aesthetic mode, people experience pleasure from a deeper understanding and appreciation of nature in its context. If a person’s mode of viewing a landscape can be changed from a scenic to an ecological one, such as through the provision of ecological information, it may be possible to influence his or her preferences toward the landscape, which can lead to improved ecological outcomes (Gobster, 1999). The effect of ecological information on preferences for landscapes and the environment has been tested in several empirical studies, with mixed results. One body of research has supported the theory that ecological information can positively influence preferences associated with challenging management issues such as wildfire management (Ryan, 2012) or acceptance of alternatives to clearcut logging (Ford, Williams, Bishop, & Hickey, 2009). Other researchers testing the effect of ecological information on perceived scenic beauty and acceptance of different woodland restoration options did not find any evidence that the provision of information can influence preferences (Hill & Daniel, 2007).

Influencing preferences is clearly more complicated than simply providing information. Preexisting values, beliefs, and attitudes play important roles in processing information (e.g., Munro & Ditto, 1997; Wood, 2000). Biased assimilation describes how information is processed (i.e., accepted or rejected) in a way that is consistent with existing cognitions (Lord et al., 1979). This phenomenon has been described by others as biased processing or defensive processing (Teel, Bright, Manfredo, & Brooks, 2006; Wood, Rhodes, & Biek, 1995). The concept of biased assimilation has been applied to a range of sociopolitical issues (Munro & Ditto, 1997), such as capital punishment (Lord et al., 1979), nuclear energy (Plous, 1991), and environmental issues (Teel et al., 2006). Several more recent studies have explored the role of beliefs in influencing perceptions through the provision of information about environmental issues (e.g., Boomsma & Steg, 2013; Ford et al., 2009). These studies found that the provision of information is more likely to influence perceptions if beliefs toward an issue are held strongly rather than weakly.

A number of cognitive concepts have been identified that are relevant to the study of biased assimilation in human dimension in wildlife. For example, a scale to measure patterns of basic beliefs toward wildlife was developed by Fulton, Manfredo, and Lipscomb (1996), and is known as wildlife value orientations (WVO). This scale includes eight dimensions: wildlife use, wildlife rights, recreational wildlife experiences, bequest/existence, hunting/anti-hunting, residential wildlife experience, wildlife education, and fishing/anti-fishing. This scale has been found to be useful in different cultural contexts, such as Germany, the Netherlands, and China (Hermann, Voß, & Menzel, 2013; Jacobs, Vaske, & Sijtsma, 2014; Zinn & Shen, 2007). Value orientations can influence landscape preferences (Kaltenborn & Bjerke, 2002), which are measured by how much people like or dislike different types of landscapes (Kaplan & Kaplan, 1989).
According to the concept of biased assimilation, value orientations are anticipated to mediate incoming information (Lord et al., 1979).

Being part of the ecological aesthetic debate (Gobster et al., 2007), wetlands are ideal landscapes to explore the two theories of ecological aesthetics and biased assimilation. In urban areas, wetlands are an essential contributor to wildlife conservation (e.g., McKinney, Raposa, & Cournoyer, 2011), are critical components of water management systems (e.g., Urbonas & Stahre, 1993), and have significant recreational and aesthetic values (e.g., Boyer & Polasky, 2004; Syme, Fenton, & Coakes, 2001). However, these roles are not necessarily in balance and planners and managers face challenges when designing wetlands to simultaneously meet ecological and aesthetic goals. Wetlands can challenge cultural expectations for landscapes that provide cues for neatness, care, control, and safety (Nassauer, 1995, 2004). Studies have shown that wetland features such as trees, open water (Dobbie, 2013; Doss & Taff, 1996; Nassauer et al., 2001), and vegetation complexity (Dobbie, 2013; Doss & Taff, 1996) elicit positive responses from people. However, wetland features that appear “messy” such as emergent aquatic vegetation (Dobbie, 2013; Doss & Taff, 1996) and tall grass along stream banks (in contrast to mown grass) have been shown to be less preferred by people (House & Sangster, 1991). Yet it is exactly these properties of natural wetlands that are likely to enhance their ecological and biological functions (e.g., Engelhardt & Ritchie, 2001).

Research questions

Consequently, the aim of this study was to test the theories of ecological aesthetics and biased assimilation using an experimental design with urban wetlands as a model landscape where conflicts between ecological qualities and aesthetic may occur (Figure 1). The three research questions were: (a) what are nearby residents’ aesthetic preferences for wetlands in an urban and Australian context, (b) how are these preferences different when people are provided with ecological information, and (c) how do WVOs mediate ecological information and influence

Figure 1. Conceptual framework to investigate the effect of ecological information (using insectivorous bats as the model species) on preferences toward wetlands and the mediating role of wildlife value orientations (Fulton et al., 1996), which was anticipated to occur when value orientations were strongly held (Boomsma & Steg, 2013). Framework adapted from the ecological aesthetics (Gobster, 1999) and biased assimilation (Lord et al., 1979) theories.
preference for urban wetlands? Ecological information was provided by the quality of a wetland as bat habitat given that the study described here was part of a broader project exploring ecological drivers of biodiversity patterns in insectivorous bats (Caryl, Lumsden, van der Ree, & Wintle, 2016; Straka, 2015; Wilson, 2013).

**Methods**

**Study area**

The study was undertaken in Melbourne, the capital city of the State of Victoria, Australia. With approximately 4.5 million people, Melbourne is Australia’s second largest city and the most rapidly growing greater capital city in Australia (ABS, 2016). Wetlands were numerous and covered large areas in Melbourne before European settlement (Presland, 2009). Urbanization and agricultural practices caused extensive wetland loss. Although remnant wetlands still occur, most of Melbourne’s current wetlands were constructed for stormwater management, water quality protection, flood abatement, and public recreation (Melbourne Water, 2012). These remnant and constructed wetlands are distributed across the greater Melbourne region, vary in their features (e.g., density of riparian vegetation, emergent aquatic plant communities, size and environmental surroundings), and provide essential habitats for a variety of wildlife (e.g., Hamer, Smith, & McDonnell, 2012).

**Developing the survey instrument**

Photographs are commonly used in landscape preference studies and are a reliable and accurate method for measuring preferences for landscapes (Stamps, 1990). Photographs were taken of 58 wetlands randomly selected from all wetlands within a distance of 60 km (37 mi) from Melbourne’s central business district.

**Pilot survey**

A pilot survey was undertaken to find groups of similarities among wetlands and to test the use of Fulton et al.’s (1996) WVO scale in an urban Australian context. Twelve participants from different socioeconomic, geographic, and cultural backgrounds took part in the pilot study. Participants were first asked to sort the 58 wetland photographs using a multiple photograph-sorting technique (Canter, Brown, & Groat, 1985) into groups based on perceived similarity along a gradient of a particular attribute they felt was important. Participants could decide on the particular attribute and the number of groups. This process was repeated several times until participants could not identify any new attribute by which to sort.

Similarity of wetland photographs was determined by counting the number of times participants placed each pair of photographs into the same group. A non-metric multidimensional scaling (nMDS) analysis was used for exploring similarity among photographs. The most important wetland attributes were identified by visual assessment of the nMDS results. Two main categories of wetland photographs were identified from the nMDS and labeled as: (a) wetlands with more vegetation (more trees closer to the wetland edge, more foreground vegetation, more vegetation overhanging water, more aquatic vegetation and obscured wetland edges) and (b) wetlands with less vegetation (fewer...
trees or trees further from the wetland edge, less visible foreground vegetation [which also makes the wetlands appear more distant], more open water, little visible emergent aquatic vegetation and visible wetland edges). A final selection of 27 photographs was made to provide good representation of both wetland factors (13 from the “more vegetation” factor, and 14 from the “less vegetation” factor) identified in the nMDS.

The second part of this pilot survey was used for testing the validity of the eight dimension WVO framework developed in the United States (Fulton et al., 1996) and whether it would adapt to an urban and Australian context (e.g., “Colorado” was replaced with “Melbourne” and “outdoors, like camping, hiking or sightseeing” with “outdoors, like visiting an urban park”). Participants were asked to think aloud when completing the questionnaire. This highlighted a number of items that were not perceived to be relevant to the urban Australian context (e.g., misunderstanding questionnaire items, items irrelevant to the urban environment). Fourteen items covering four WVO dimensions (bequest/existence, wildlife rights, recreational wildlife experiences, wildlife education) were used in the final instrument (see Appendix 1 in the Harvard Dataverse for a description of adapting the WVO).¹

**Ecological information**

Insectivorous bats were used as a model species for the provision of ecological information as this study was part of a broader project on urban bats. Habitat indicator symbols were developed for each wetland photograph based on bat diversity and insect abundance (bat prey) data collected at each of the 58 sites where photographs were taken, and independent ratings of five bat experts (see Appendix 2 in the Harvard Dataverse for habitat indicator symbols). Habitat indicators ranged from 1 (poor bat habitat quality [e.g., only one bat species present and low abundance of insects found]) to 5 (excellent habitat, up to 12 bat species present and high abundance of insects found) and were indicated using stylized bat symbols. An information flyer on insectivorous bats was prepared containing a photograph of an insectivorous bat and some simple statements about their biology and ecology, and the ecosystem services they provide (e.g., eating 600 mosquitoes an hour). The importance of urban wetlands for insectivorous bats as drinking and foraging grounds (e.g., Stahlschmidt, Pätzold, Ressl, Schulz, & Brühl, 2012) and why insectivorous bats require protection was emphasized in this information (see Appendix 2 in the Harvard Dataverse for information flyer on insectivorous bats).

**Final survey instrument**

The final survey material consisted of a cover letter, an A5-sized photograph-booklet (containing color photographs of 27 wetlands, size 8 cm × 11 cm, see Appendix 2 in the Harvard Dataverse for photo booklet), and a five-page questionnaire. The order of photographs was randomized and two booklets were created to present the same wetland photographs, but in two different orders to minimize order bias (Bryman, 2008). The questionnaire included three sections. In the first section, participants were asked how much they liked each wetland presented in the photograph booklet on a 7-point scale (1 = “Don’t like it at all” to 7 = “Like it very much”) to measure their preferences for urban wetlands, consistent with many previous landscape preference studies (e.g., Kaplan &
Kaplan, 1989). In the second section, people were asked about their WVOs, again captured on a 7-point scale measuring their level of agreement (1 = “Don’t agree at all” to 7 = “Strongly agree”). In the last section, demographic information was collected on the respondents’ sex, age, education, language spoken at home, and membership in an organization with an interest in nature.

To investigate the influence of information on preferences, participants were randomly assigned to one of two equal-sized groups: (a) received ecological information from the information flyer (hereafter “with information”) and (b) did not receive ecological information (hereafter “without information”) (see Appendix 2 in the Harvard Dataverse for photo booklet). There was a risk that insectivorous bats might evoke negative responses in some respondents (Knight, 2008), so the “with information” group was asked their awareness about insectivorous bats prior to the survey and an extra four statements (Table 1) assessing their beliefs about these nocturnal mammals. These were chosen and adapted from a framework developed in the United States (Sexton & Stewart, 2007), and again measured on a 7-point scale (1 = “Don’t agree at all” to 7 = “Strongly agree”).

### Survey participants and distribution

A total of 1,200 participant addresses were randomly selected from a government address database (DSE, 2009) from those residents living within a 1 km (.6 mi) buffer around the 58 wetlands. Participant selection was processed using ESRI ArcMap GIS software (version 10). The person over 18 years of age with the next birthday in the household was asked to fill out and return the questionnaire. An adapted Dillman, Smyth, and Christian (2014) approach was used for the questionnaire distribution, consisting of two mailings of the questionnaire. The first mailing contained the questionnaire, postage-paid return envelope, and an incentive for participants who responded to be placed in a draw for one of five double cinema tickets to maximize the response rate. After 2 weeks, a reminder letter with the complete questionnaire packet was sent to people who had not responded.

### Statistical analysis

Exploratory factor analyses (EFA) with oblique rotation and unweighted least squares/minres were used to identify the underlying structure of people’s wetland preferences and to validate the factor structure of the revised WVO scale. Although the WVO scale has been validated in multiple studies, the wording of scale items was revised in a number of places to adapt the scale to an urban and Australian context. The WVO scale has, to the

| Statements                                                                 | Mean rating (± SD)¹ |
|---------------------------------------------------------------------------|---------------------|
| Insectivorous bats should be protected                                    | 6.3 (± 1.2)         |
| Insectivorous bats are an important component of a healthy ecosystem      | 6.2 (± 1.1)         |
| Insectivorous bats are frightening                                        | 1.7 (± 1.2)         |
| Insectivorous bats are a nuisance animal in Melbourne                     | 2.0 (± 1.4)         |

¹ Ratings ranged from 1 (Don’t agree at all) to 7 (Strongly agree)
authors’ knowledge, not previously been validated in Australia, where concerns about wildlife have been shown to vary from those identified in other countries (Miller, 2009). More generally, domination/utilitarian dimensions of WVO scales have been shown to have variable internal consistency in cross-cultural contexts (Hermann et al., 2013). The number of factors to extract was chosen by examining scree plots and eigenvalues > 1. The pattern matrices of oblique rotations were used to assign wetland photographs (see Figure 2) and WVOs (see Appendix 3 in the Harvard Dataverse for WVO factors) in each factor when their loading value on each factor was greater than .40. Cronbach’s alphas were then calculated for each factor to test for reliability, with values above .75 considered as having high reliability (Hinton, Brownlow, McMurray, & Cozens, 2004). Preference scores for wetland factors were calculated by averaging ratings for all photographs loading on each factor for each respondent separately. Similarly, WVO factor scores were created by averaging statement ratings of each factor (hereafter dimensions) for each respondent.

A paired t-test was applied to investigate significant differences of all respondents’ wetlands preferences between the two wetland factors (more and less vegetation), using the mean preference scores for each factor. Cohen’s d was calculated to assess effect size with values of .20 interpreted as minimal, .50 as typical, and .80 as substantial (Vaske, 2008). The experiment was designed to examine the relationship between wetland preferences, ecological information (ecological aesthetics), and strong and weak wildlife value orientations (biased assimilation), and allowed a multifactor analysis of variance (ANOVA) test to performed for each condition. A one-way ANOVA was used to compare the mean preference scores of the groups with and without information within and between each wetland category, to investigate how wetland preferences differed within one wetland category when people were given information (testing the theory of ecological aesthetics). To investigate the mediating effect of strongly or weakly held WVO (testing the theory of biased assimilation) on the ecological aesthetics, each WVO dimension was split into two groups (following Teel et al., 2006), representing those below (hereafter weak value orientations) and above (hereafter strong value orientations) the median score of each WVO dimension. A one-way ANOVA was then used to compare mean preference scores among people with and without information and all three WVO dimensions; separately for weak and strong value orientations. For each case, where significant differences were found, a Tukey’s honest significant difference (HSD) post-hoc test was conducted to correct for multiple comparison and eta (η) calculated as effect size measure with values of .10 interpreted as minimal, .30 as typical, and ≥ .50 as substantial effect sizes (Vaske, 2008).

**Results**

A total of 198 questionnaires were returned (17% response rate); 108 from the group with information and 90 from the group without information. Although this response rate is somewhat low, it is consistent with recent surveys of the general public on environmental matters in Melbourne that have response rates ranging from 6% to 11% (Ives & Kendal, 2013; Shaw, Miller, & Wescott, 2013). This response rate allows a comparison of WVOs and preferences, but limits the ability to generalize results to the entire population being sampled. In comparison to census data for Melbourne (ABS, 2011), the returned sample was slightly more likely to contain females (64% compared to the census of 51%).
approximately same aged (a mean age of 45–54 years, compared to the census mean of 46 adjusted to exclude people under 18), more highly educated (66% holding at least a diploma degree), and slightly less culturally diverse (81% of respondents spoke only English at home, compared with the census of 66%). Most respondents (81%) were not members of nature organizations. Both groups (with and without information) were similar in their demographic profiles.

**Wetland preferences**

The EFA of preference ratings found an underlying structure of two factors, explaining 52% of the variation in the data, and which were similar to the two categories identified in the pilot survey. A reliability analysis revealed high internal reliability with Cronbach’s alpha of .91 and .94 for each wetland factor (Figure 2). The factors were consistent with the results of the pilot survey with the first factor containing wetlands with more vegetation (n = 13) and the second containing wetlands with less vegetation (n = 10). The remaining four wetlands did not load clearly on either factor and were excluded from further analysis. The factors had significantly different habitat characteristics; wetlands with more vegetation had a mean bat habitat score of 4.2 and wetlands with less vegetation had a mean bat habitat score of 2.6. Respondents from both the “with information” and “without information” groups preferred photographs of wetlands with more vegetation (i.e., better bat habitat, M = 5.2) significantly more than photographs with less vegetation (i.e., poorer bat habitat, M = 4.2), t (197) = 13.01, p < .001, d = .92. This effect size was substantial.

| Factor 1: More vegetation (41.6%) | Factor 2: Less vegetation (10.7%) |
|----------------------------------|----------------------------------|
| Elizabeth .88                   | Boardwalk .89                    |
| Redleaf .84                     | Cherryb .75                     |
| VaRessa .83                     | Albert .77                      |
| Braeside .82                    | Traganina .76                   |
| VaRess .80                      | Cherryb .75                     |
| Lakewood .79                    | Jacknapper .62                   |
| Bearview .75                    | Stocklandsb .61                  |
| Lilydale .67                    | Eltewick .59                     |
| Blackburn .64                   | Hanco .46                       |
| Landeen .63                     | Woodland .42                    |

Cronbach’s alpha: .94

Cronbach’s alpha: .91

**Figure 2.** Wetland preference factors. Photographs loading highly on each factor are shown with loading values.
Awareness and beliefs about insectivorous bats

Awareness of insectivorous bats was low, with 77% of the respondents receiving ecological information previously unaware that insectivorous bats occurred in Melbourne. Respondents had generally positive beliefs about insectivorous bats; shown by the high scores on positive statements and low scores on negative statements (Table 1). These results were similar for people who were aware or unaware of insectivorous bats prior to the survey and confirmed that using insectivorous bats as the basis of ecological information was acceptable and would not necessarily bias responses due to strong negative attitudes toward bats.

Influence of ecological information

There was a significant effect of information on wetland preferences with a typical effect size, $F(3) = 31.30, p < .05, \eta^2 = .44$. People who received ecological information had significantly (Tukey’s HSD, $p < .05$) lower preferences for wetlands with less vegetation ($M = 4.0$ with information, $M = 4.5$ without information, Figure 3). However, no significant differences in preferences were found for wetlands with more vegetation ($M = 5.2$ with information, $M = 5.1$ without information, Tukey’s HSD, $p > .05$).

WVOs in an urban Australian context

Three WVO factors were revealed by the EFA (see Appendix 3 in the Harvard Dataverse for WVO factors revealed by EFA), explaining 66% of the variation in participants’ responses. These were found to have high reliability (Cronbach’s alpha = .93 to .77). Statements from Fulton et al. (1996) original two dimensions, bequest/existence and wildlife education, loaded on one factor, which was labeled “bequest and education.” The factor structure of the remaining two factors, wildlife rights and recreational wildlife experiences, were consistent with the dimensions identified by Fulton et al. (1996). Two of the 14 statements (one from recreational wildlife experiences and one from wildlife education) did not load clearly on any single dimension, so were removed from subsequent analysis. Overall, respondents held strong WVOs, shown in high mean scores for

Figure 3. Preferences for wetlands with more and less vegetation for respondents without (grey dots, $n = 90$) and with (black dots, $n = 108$) ecological information. Mean and 95% confidence intervals are shown. Values with different letters within wetland groups are significantly different (Tukey’s HSD, $p < .05$).
each dimension (bequest and education mean = 6.1, wildlife rights mean = 5.1, and recreational wildlife experiences mean = 5.7).

The mediating effect of strongly held WVO on wetland preferences

There was a significant effect of strongly held WVOs on preferences for wetlands with less vegetation with a typical effect size, $F(5) = 4.81, p < .05, \eta = .30$. People with strongly held WVOs had significantly lower preferences for wetlands with less vegetation when they were given information (particularly for two of them: wildlife rights and recreational wildlife experiences, Tukey’s HSD, $p < .05$), but there were no significant differences in preferences for people with low WVOs (Figure 4). For wetlands with more vegetation, ecological information had no significant influence on preferences, regardless of WVOs (Figure 5).

**Figure 4.** Preference scores for wetlands with less vegetation by strong and weak WVO and for respondents with (black dots) and without (grey dots) ecological information. Mean preference ratings and 95% confidence intervals are shown; different letters within value orientations factors are significantly different (Tukey HSD, $p < .05$). Beq&Edu = bequest and education, Rights = wildlife rights, Recreation = recreational wildlife experiences.

**Figure 5.** Preference scores wetlands with more vegetation by strong and weak wildlife value orientations (WVO) and for respondents with (black dots) and without (grey dots) ecological information. Mean preference ratings and 95% confidence intervals are shown; same letters are not significantly different from each other (Tukey HSD, $p > .05$). Beq&Edu = bequest and education, Rights = wildlife rights, Recreation = recreational wildlife experiences.
Discussion

Wetland preferences

Wetlands with more vegetation (and higher quality habitat for bats) were significantly more preferred than wetlands with less vegetation (and lower quality habitat for bats), regardless of whether or not respondents were provided with ecological information. The high effect size indicated that a substantial difference between both means existed (Vaske, 2008). This suggests that wetlands with more trees, understorey, and emergent aquatic vegetation that were found to support bat species richness and their prey availability in a previous ecological survey are preferred by nearby wetland residents in an urban Australian context.

Statistical support was found for two wetland factors (more vegetation and less vegetation), which limits comparison to previous studies that had a higher number of factors investigating perceptions of wetlands (e.g., Dobbie, 2013). Nevertheless, aligning with other studies from the United States and Australia, trees (Dobbie, 2013; House & Sangster, 1991; Nassauer et al., 2001), vegetation complexity (Dobbie, 2013; Doss & Taff, 1996), and naturalness (House & Sangster, 1991; Nassauer et al., 2001) were found to be preferred aspects of wetland landscapes. However, wetlands with more vegetation also had a higher density of emergent aquatic vegetation and wetland edges that were obscured rather than visible. These characteristics of urban wetlands are less preferred by people (e.g., Dobbie, 2013), lead to lower house prices (Doss & Taff, 1996; Mahan, Polasky, & Adams, 2000), and are perceived as unsafe (Syme et al., 2001). These inconsistencies with earlier findings may be explained by the relative importance of trees as a driver of wetland preferences (Dobbie, 2013; House & Sangster, 1991; Nassauer, 1995) in comparison with emergent vegetation or obscured edges. In our study, wetlands with more vegetation had more riparian trees than wetlands with less vegetation, and this may be a stronger driver of preference than emergent aquatic vegetation.

Influence of ecological information

Ecological information was found to have a moderate influence on preferences toward urban wetlands. However, results unexpectedly showed that preferences for wetlands with more vegetation were not increased by learning about the ecological benefits of these wetlands. Instead, people who received information about the ecological disadvantages of a landscape had lower preferences than those who did not receive this information. The ecological aesthetic is defined as people “seeing” and experiencing a landscape in an ecological aesthetic mode rather than a scenic aesthetic one, and is induced by a deeper understanding and appreciation of nature in its context (Gobster, 1999). These results suggest a shift in preferences when people learned about the ecological disadvantages of a particular kind of wetland. Thus, negative ecological information reduced appreciation of a landscape with poorer ecological qualities. As wetlands with more vegetation were highly preferred by participants, it is likely that this masked any positive effect of ecological information; people did not need to understand more about the ecological benefits of these wetlands to appreciate them or perceive them as more attractive.

This study confirms that ecological information is able to influence preferences toward a landscape, consistent with previous studies (e.g., van der Wal et al., 2014). A conflict
between aesthetics and ecology is often assumed (Parsons, 1995), however, may be mitigated through the provision of suitable information. Nevertheless, ecology and aesthetics can already be aligned in some landscapes and may not require special endeavors to gain acceptance as demonstrated in this study of preferences for wetlands in an urban Australian context. This pattern has also been found in agricultural landscapes in the Palouse farming region of Washington, USA (Klein et al., 2015). Furthermore, the direction in which preferences (or other cognitive constructs such as attitudes) are influenced should not be assumed. Ecological information has been shown to elicit positive effects (e.g., Ford et al., 2009; Ryan, 2012), no effect (e.g., Hill & Daniel, 2007), and, as found in this study, negative effects (e.g., Brunson & Reiter, 1996).

Strongly held WVOs lead to biased assimilation

Information was found to be processed in a biased fashion, as people with strong WVOs (namely wildlife rights and recreational wildlife experiences) had moderately different preferences when provided with information about the poor habitat quality (less vegetation) of wetlands. These results provide evidence that lower-level cognitive concepts such as WVOs can influence the processing of information, consistent with the biased assimilation theory (Lord et al., 1979). Information that wetlands with less vegetation provide poor habitat for insectivorous bats (referring to wildlife rights) and that people are unlikely to experience wildlife at these wetlands (referring to recreational wildlife experiences) was inconsistent with these two strong basic beliefs of respondents. As a result, these wetlands were less preferred. In contrast, people with weak WVOs were not significantly affected by this information. This effect was only found to be significant when value orientations were strong, which is consistent with previous research that found that information is more likely to be effective when it supports people’s strong beliefs about an issue. For instance, a study in the Netherlands on acceptance of reduced street lighting found that people who held strong biospheric beliefs responded most strongly to information on environmental impacts (Boomsma & Steg, 2013).

Although this study is correlative and did not measure change in preference before and after the provision of information, it provides support for the notion that strongly held WVOs lead to biased assimilation of incoming information. Results highlights the benefit of including information that is congruent with value orientations for effective communication on nature-related issues, and suggest that targeting high value orientations could be a useful tool for influencing preferences for ecological landscapes. These results emphasize the importance of considering cognitive constructs such as value orientations in the management of ecological systems (Ives & Kendal, 2014), particularly given long-term shifts in conservation-related values that are occurring in society (Manfredo, Teel, & Dietsch, 2016).

The association between the provision of ecological information and cognitive change is complex, and at least partially based on biased assimilation due to deeper cognitive constructs such as WVOs. Further studies are required to understand the mechanisms that underpin these changes (Wood, 2000).
**WVOs in an urban Australian context**

Two dimensions of the WVO scale developed in the United States, wildlife rights and recreational wildlife experiences, were found to be reliable and had predictive value for use in an urban Australian context. Statements on bequest/existence and wildlife education loaded on a single dimension. This dimension was rated highly by participants, indicating strong bequest and educational values for wildlife in Melbourne. This is consistent with a study on values for wildlife in Victoria, which found that an interest in learning about wildlife was one of the most important values people held for wildlife (Miller, 2000). The original eight dimensions found by Fulton et al. (1996) can be grouped into two contrasting ideologies, namely mutualism and domination (Manfredo, 2008; Manfredo, Teel, & Henry, 2009). The mutualism ideology represents a more caring and social affiliation for wildlife, whereas the domination ideology reflects human mastery over wildlife (Manfredo, 2008; Manfredo et al., 2009). The four dimensions used in this study (bequest/existence, wildlife rights, wildlife education, wildlife recreational experiences) were from the mutualism ideology (Manfredo, 2008; Manfredo et al., 2009). Miller (2000) showed that the domination ideology (such as values on dominionistic/wildlife-consumption and utilitarian-habitat), are not structured in the same way by Australians, which is consistent with studies from outside the United States (e.g., Hermann et al., 2013). It is also likely that the ideology of domination over wildlife is likely to be less relevant in urban areas (Manfredo, 2008; Manfredo et al., 2009).

The sample in this study also had different beliefs about bats than those described in previous studies, which have tended to show strong negative responses to bats (e.g., Knight, 2008). This is perhaps due to the absence of disease association (e.g., rabies) or the general lack of awareness of bats among urban Australians, and highlights the need to more research in different social and ecological contexts to better understand varied responses to wildlife.

**Further research**

Respondents in this study were living close (within 1 km [.60 mi]) to wetlands. As familiarity to their local wetland is likely to have influenced perceptions (Brody, Highfield, & Alston, 2004), further research is required to improve understanding of the value orientations and preferences of the broader urban public. Furthermore, the generally high scores on WVOs of respondents in this study (means ranging from 5.1 to 6.1) could be attributed to respondent bias, as people with an interest in wildlife were more motivated to respond to the questionnaire than those with less interest in wildlife. Although a nonresponse bias check was not conducted, this bias is generally acknowledged (e.g., Teel et al., 2006) and means that the high scores of WVOs observed here should not be extrapolated to the general population. The high level of preference for wetlands that provided good habitat for insectivorous bats was somewhat surprising. When information was provided, there was no increase in preference detected for these wetlands, perhaps because these landscapes are already charismatic. Further research should explore less charismatic landscapes with important ecological values, such as grasslands (Williams & Cary, 2001), to determine whether the provision of ecological information congruent with values and beliefs could lead to increased preference by encouraging an ecological aesthetic.
Conclusions

These findings provide several lessons for managers and planners of urban landscapes. First, urban planners need to be cognizant of what the public likes in their open space to garner acceptance and continued support for these habitats (Nassauer et al., 2001). In this study, naturalistic urban wetlands, even with emergent aquatic vegetation and obscured edges, were preferred. This shows that wetlands with high ecological quality can be appreciated by people in urban Australia. Second, and perhaps more importantly, where ecological information is congruent with low level cognitive constructs such as WVOs, it may be more effective in influencing higher order cognitive constructs such as preferences because people will process this information in ways that are consistent with their existing beliefs. Understanding and targeting beliefs (Boomsma & Steg, 2013) or value orientations (Bright, Manfredo, & Fulton, 2000; Lange, 1993) to provide better messages for addressing environmental conflict is not a new concept. However, mechanisms underpinning the influence of information are still poorly understood. Where people do not have positive environmental value orientations, it is unlikely that interpretive information on ecological issues alone will be effective in changing preferences. The question of how to influence people with weak environmental beliefs and value orientations remains.

These are particularly important findings for cities where managers and designers hope that remnant or constructed nature in places such as wetlands and parks are appreciated by people, and information is regularly provided through interpretation and education materials to improve appreciation. Finding appropriate tools to manage urban areas that benefit biodiversity and are appreciated by people is crucial in the context of ongoing worldwide urban growth coupled with the need to implement international environmental agreements for biodiversity conservation, such as the Convention on Biological Diversity.

Note

1. Details about the development of the survey material and loadings of WVO factors of Melbourne’s residents (EFA) are deposited as Appendices 1–3 to Harvard Dataverse and are accessible under doi: http://dx.doi.org/10.7910/DVN/0VHZOJ.

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