Energy Policy 122 (2018) 601–611

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Seeing clearly in a virtual reality: Tourist reactions to an offshore wind project

Mario F. Teisl[a,*], Caroline L. Noblet[a], Richard R. Corey[b], Nicholas A. Giudice[b]

[a] School of Economics, University of Maine, USA
[b] Virtual Environment and Multimodal Interaction (VEMI) Laboratory, University of Maine, USA

ARTICLE INFO

Keywords:
Offshore wind energy
Virtual reality
Tourism

ABSTRACT

Most research to elicit citizen's reactions to proposed windfarms use either no visuals (relying on text) or static representations (e.g., 2-D photos or drawings); we develop and test a virtual reality (VR) tool to determine whether increased information – in the form of VR – alters tourists' perceptions, attitudes, concerns and behaviors related to a proposed siting of wind turbines. Tourists using the VR were better at evaluating the impact of wind turbines on their experience and forecasting how their behavior may change. Also the VR caused respondents, on average, to have more negative reactions.

1. Introduction

To meet the increasing demand for energy while reducing dependence on fossil fuels, many areas in the world have been heavily investing (US$ 110 billion in 2015) in both onshore and offshore wind; these investments increased global wind power capacity by 64 GW in 2015, a 17% increase (WEC, 2016). However, the impact of these newly sited technologies on the quality of life of local residents and visitors can be incredibly difficult to envision yet this understanding is crucial, given the importance of local visual impacts in focusing opposition to wind farms in locations across the globe (Phadke, 2010). A research tool allowing local stakeholders to experience a project's visual impact on the local context could: reduce stakeholder misperceptions (leading to buyer's remorse[1]), identify visual adjustments to reduce stakeholder concerns and identify populations who may be more open to new information about the project.

Most research to elicit citizen's reactions to proposed windfarms have used either no visuals (relying on text descriptions) or static representations (e.g., 2-D photos or drawings).[2] However, recently computer simulations are being used in wind planning (see Fooks et al., 2017; Ribe et al., 2018; Maslov et al., 2017) so it is relevant to test how computer simulations impact viewer responses.[3] We contribute to this nascent literature on computerized information provision by testing tourists' responses to a virtual reality (VR) or static picture (SP) rendering of a proposed offshore wind facility. We find VR respondents felt they had more information and less decision uncertainty than those seeing a SP. VR respondents also held relatively more negative or more extreme views of the wind turbines, and on average, reduce their stated intention to visit. This suggests that non-VR studies may collect data based on stakeholders' (overly optimistic) misperceptions of the visual impacts of the wind project on their visitation experience; which would lead proponents and developers to underestimate potential future resistance to the wind project. In addition, once the wind farm is realized, stakeholders would update their perceptions and have buyer's remorse. We suggest the VR is a better visualization tool as it situates the windfarm within the local context.

2. Previous research

2.1. Wind energy and visualization

Although visual aesthetics are the primary driver of wind energy acceptance (Wolsink, 2007, 2010; Betakova et al., 2015; Molnarova et al., 2012), many previous acceptance studies have not used visuals (Mirasgedis et al., 2014; Georgiou and Areal, 2015), relying on text and the ability of respondents to imagine turbines, or to apply previous experience to the current situation (Hevia-Koch and Ladenburg, 2016; Firestone et al., 2018). However, this lack of visual aids may be

* Corresponding author.
E-mail address: teisl@maine.edu (M.F. Teisl).

[1] Suggested by an anonymous reviewer.
[2] Visual impact assessment is often used in environmental impact assessment (Chias and Abad, 2013).
[3] Even if we are unable to determine the mechanism underlying these response differences.

https://doi.org/10.1016/j.enpol.2018.08.018
Received 12 December 2017; Received in revised form 6 August 2018; Accepted 7 August 2018
0301-4215/

problematic because wind turbine acceptance is driven by a number of project-specific attributes, including number, size and density of turbines, distance from viewpoint, features of the landscape and the location of the turbines within the landscape (Bishop and Stock, 2010; Bishop and Miller, 2007; Hevia-Koch and Ladenburg, 2016; Firestone et al., 2018; Filova et al., 2015; Svobodova et al., 2015). Indeed, even the composition of the photo can affect preferences (Svobodova et al., 2014).

Static renderings (site specific see Knapp et al., 2013; artistic rendering see Strazzera et al., 2012) may not provide full information to participants as human sight responds more to moving objects (Franconeri and Simons, 2003) and turbines in motion are viewed as more beautiful and more economically productive than those not in motion (Fergen and Jacquet, 2016). The literature also suggests multiple mechanisms or explanations for why responses to a static picture would differ from VR. Heft and Nasar (2000) note that generally "perceivers are moving with respect to, and often through, the environment" (pg. 302), making a dynamic presentation more consistent with lived experience. Thus, static imagery may be insufficient when presenting moving elements within an environmental context (Hetherington et al., 1993), particularly with respect to wind energy installations (Jallouli and Moreau, 2009). Kaplan and Kaplan (1989) identified coherence, legibility, complexity and mystery as factors impacting preference for nature information. Heft and Nasar (2000) interpret the implications of this work by noting that "a scene is high in mystery….if it draws the perceiver into the scene with the prospect of more information" (pg. 305). Given that people generally experience motion in their environment interactions, the dynamic nature of the VR representation of the wind turbines and surrounding environs, may project the potential for more information. Psychological Distance (PD) is an individual's mental representation of resources and their perceived distance to those resources. PD is not often used in the natural resource literature (exceptions, see Spence et al., 2012; Huff et al., 2017) but is traditionally captured using four dimensions: spatial, temporal, social, and uncertainty, where PD is measured from abstractness to concreteness (Trope and Liberman, 2010). Two of these dimensions are particularly relevant to the current work: spatial and uncertainty. PD in the spatial domain is the level of abstraction when an object is physically distant (Fujita et al., 2006), while in the uncertainty domain is an individual's ability to integrate knowledge about novel concepts to create a mental representation (Trope and Liberman, 2010). Research in the environmental perception literature have noted that "static displays invite a detached viewpoint" (Heft and Nasar, 2000 pg. 317) providing further evidence of the potential for greater psychological distance from the static photo. Hevia-Koch and Ladenburg (2016) calls for rigor and care in the use of visualization, noting visualization is a "powerful tool to increase the level of information among respondents but …. (has the) potential to generate distortion" (pg. 9). Thus the use of visualization has important implications for siting of wind energy as residents and visitors may differ in their evaluation of similar visual information (Firestone et al., 2018).

People's *a priori* reactions to windfarms change as they are constructed and become fully operational (Wolsink, 2007; Ladenburg, 2009; Devine-Wright, 2005; Pasqualetti et al., 2002), where the visual impact on the local context is the dominant factor (Wolsink, 2007, 2010; Molnarova et al., 2012). This suggests *a priori* perceptions may not adequately take into account the visual impacts of a wind project (perhaps biased toward economic and environmental benefits).

2.2. Tourism and wind energy

Several authors highlight the lack of research focused on understanding tourists' reactions to offshore wind turbines (e.g., Lutzeyer et al., 2016; Ladenburg, 2010; Landry et al., 2012; Lilley et al., 2010; Westerberg et al., 2013; Broekel and Alfken, 2015), where many of the studies are in the "grey literature" (e.g., Braunová, 2013; Business and Damsbo-Andersen, 2013; Fáilte Ireland, 2012; Albrecht et al., 2013; Tourism Research Centre, School of Business, University of PEI, 2008). The studies examining tourist reactions to proposed wind turbines may (or may not) include a visual in their surveys[4] (e.g., see Landry et al., 2012; Westerberg et al., 2013; Betakova et al., 2015; Molnarova et al., 2012; Abromas et al., 2015; for a review of visualization efforts see Hevia-Koch and Ladenburg, 2016). This approach may not provide the observer with a realistic first-person perspective of how the scene would actually look which makes it cognitively difficult to imagine a proposed site. This is particularly important given visuals are key predictors of tourist visitation (MacKay and Fesenmaier, 1997), and tourists seek out rural landscapes (Devlin, 2005) and associate these areas with less technological or modern intrusions (Urry, 1992).

These studies typically show tourists are generally negative in their reactions to wind turbines, but results are not uniform (Lutzeyer et al., 2016; Riddington et al., 2008; Landry et al., 2012; Lilley et al., 2010; Fooks et al., 2017; Firestone et al., 2018), given the differences in the projects' contexts (e.g., populations and landscapes). However, studies have found between 6% and 31% of tourists stating wind turbines would change their travel destination (see Broekel and Alfken, 2015 for a review). Offshore turbines generally have a negative effect on attractiveness to tourists (Landry et al., 2012; Gee, 2010; Lilley et al., 2010; Lutzeyer et al., 2016), and can disrupt long-standing visitation patterns (Lutzeyer et al., 2016). Other studies have shown tourists are attracted to areas with wind turbines (Eltham et al., 2008; Frantál and Urbánková, 2014) in part because they may fit into the existing landscape (Frantál and Kunc, 2011). Finally, recent studies have found tourists are split; some like, while others dislike, windfarms (Fooks et al., 2017; Firestone et al., 2018). Thus we are left with an open question of how proposed offshore wind turbines would impact visitors perceptions and behaviors.

3. Conceptual framework

We assume tourist reactions to a proposed wind project reflects their prior knowledge and the experimental treatment information. The literature suggests the visual impacts of windfarms are influenced by the characteristics of the farm *and by the setting in which the farm is located*. Providing a realistic visualization of the project (blades spinning) *and* of the local setting may improve individuals' ability to update their perceptions to take the aesthetic dimension into account.

To provide a modeling framework to measure changes in tourists' reactions to the information treatments (e.g., satisfaction with the information) and to the wind project (e.g., attitudes, concerns, behaviors), one first needs to know how information enters into an individual's reactions. The reaction (RXN) function can be represented as:

$$RXN = f\ \{I_j, \mathbf{P}, \mathbf{K}, \mathbf{V}, \ \mathbf{D}, \ \mathbf{S}\} \quad (1)$$

where I_j is the information treatment (j = VR or SP), **P** is a vector of pre-existing psychometric factors (e.g., perceptions, motivations), **K** is a vector of pre-existing knowledge of, and experience with, windfarms, in general, and of the specific project, **V** is a vector of pre-existing visitation characteristics (e.g., frequency, types of trips), **D** is a vector of individual characteristics (e.g., gender, age, education), and **S** is a vector of the survey administration characteristics (e.g., who/when/where surveyed, adequate random assignment) that may explain differences in tourist reactions. The cognitive process that extracts and translates information into a reaction to the project's (information's) impact can be viewed as a 'household production' process by which an individual uses her priors (**P, K, V, D**) and the information presented during the survey. Assuming there are no survey administration issues (i.e., no surveyor, time, location or random assignment issues), then the

[4] Although use of viewsheds is increasingly critical for impact analyses & meeting regulatory guidelines.

experimental nature of the data would allow us to test the average effect of the information treatment by simplifying the reaction equation to RXN = f $\{I_j\}$.

Given the literature, we posit the following hypotheses (all are relative to the SP):

H1). The VR will provide more information about the turbines (blades spinning) leading to stronger positive and negative reactions to the turbines;

H2). The VR will provide more information about the landscape setting leading to stronger negative reactions to the turbines; and

H3). The increased information in the VR will:

a). increase respondent's level of satisfaction with the amount of information they have to evaluate the wind project;

b). decrease respondent's feelings of uncertainty about the project's impacts; and

c). reduce the percent of respondents who are indifferent, or state they have no opinion.

4. Methods

4.1. Study site

Monhegan Island (Maine, USA) is about 14 miles (22.5 km; 12 nautical miles) off the mainland. The island is accessible by ferry and is cherished for sweeping viewscapes, 'old world' charm and prime bird migration viewing. Two 6-megawatt floating deep-water offshore wind turbine prototypes[5] are to be placed approximately 2.9 miles (4.6 km; 2.5 nautical miles) from the Island. The hub height for the prototypes is 328 ft. (100 m) with a rotor diameter of 423.2 ft. (129 m). This site is of particular interest given prior studies have found siting of wind turbines in "*landscapes of high aesthetic quality*" (Molnarova et al., 2012, p. 269) cause greatest concern. Further, the Island has a history of repeat visitation, indicative of place dependency (Firestone et al., 2018) which is likely to affect tourist and local perceptions of the turbines; the negative impacts of turbines tend to be stronger in areas with location-identity attachment (Strazzera et al., 2012).

4.2. Visitor survey data collection

Data collection ran from May 29th, 2014 to August 24th, 2014, allowing for sampling of summer visitors and those visiting for the spring bird migration.[6] These dates are consistent with the start of multiple ferry trips available per day (between mid-October and Memorial Day weekend only one boat a day is available). Two undergraduate research assistants traveled to Monhegan Island on a weekly basis to perform intercept surveys with island visitors. Surveyors intercepted people at various locations on the Island (Table 1) but most data were collected either in the center of the village, or at the ferry landing (both in Region A, Fig. 4), because these locations were more open than a walking trail and visitors were more amenable to being surveyed while waiting for the ferry; leading to an almost 100% survey acceptance rate. Only one person per party was surveyed and people/parties were not resurveyed.

The project's main goal was to evaluate how visitors may react to the wind turbines. As such, we targeted visitors with no other compelling reason to visit Monhegan; i.e., we did not include business visitors or people who primarily were visiting family. In total, 181 surveys were collected; however, we dropped three individuals on business travel.

[5] Information about the *Aquaventus* project is available at http://maineaquaventus.com.

[6] Dates do not encompass traditional fall bird migration season (mid-September).

Table 1
Characteristics of visitors' trips by survey version, and knowledge levels of respondents.[a]

	Static photo	Virtual landscape	statistic; p-value[b]
Percent taking a single-day trip	60	54	0.62; 0.42
Percent taking a multi-day trip	40	46	
Average number of nights on this trip	5.2	5.5	0.30; 0.76
Percent staying in a bed and breakfast	48	38	0.89; 0.34
Percent staying in a rented house/ apartment/cottage	52	62	
Average number of single-day trips taken annually	0.4	0.8	1.29; 0.20
Average number of multi-day trips taken annually	**1.0**	**0.6**	1.65; 0.10
Percent traveling with others	91	95	1.26; 0.26
Average number of adults accompanying visitor	2.5	2.5	0.17; 0.86
Average number of children accompanying visitor	0.6	0.4	1.43; 0.15
What areas of the island are you visiting during your trip? (Percent stating)[c]			
Region A – Monhegan village and boat landing[d]	93	91	0.35; 0.55
Region B – Monhegan's north shore	58	63	0.37; 0.54
Region C – Monhegan's east shore	76	75	0.05; 0.82
Region D – Monhegan's south shore	65	72	0.97; 0.32
Percent knowing about Monhegan windfarm plans	43	39	0.25; 0.62

[a] **BOLD** indicates a significant difference across survey version, at the 10% significance level.
[b] Statistics reported are chi-square results except: average number of nights, trips, and adults and children accompanying which are *t*-test statistics.
[c] Percents may not sum to 100 since multiple categories could be chosen.
[d] Refer to Fig. 4.

4.2.1. Survey design

Consistent with our objectives to test differing provision of information, two survey versions were deployed to participants via iPad®. One version showed visitors a traditional two-dimensional picture of the wind turbines (Fig. 1) while the other version presented a 3-dimensional virtual landscape allowing them to view dynamic wind turbines (with blades spinning) and a 360° view of the landscape (viewed by holding the iPad® and spinning the body and by looking up and down). Both the photo and virtual landscape (see Appendix A for information about how the VR was constructed) were rendered from the same on-shore location at Lobster Cove, a vantage point at the southeast of the island (Figs. 2–4).

The survey contained three sections (see Appendix B). Section one consisted of questions aimed at understanding the visitation patterns of visitors (Table 1), and their motivation for visiting (Table 2). Section two began by asking questions about where wind turbines should be located and whether the respondent knew about the proposed wind project (Table 3). *After* these questions, the respondent saw one of the turbine visualizations (the visualizations were randomly assigned to respondents), *followed* by a series of questions aimed at assessing their reactions to 1) the information they have, 2) the impacts of the wind turbines and 3) how this would affect subsequent visitation (Tables 4, 5). The last section asked about the visitor demographics (Table 6). We did not provide respondents any other information about: the wind turbines, current electricity prices, how electricity is currently produced on Monhegan (large diesel generator) and/or details of the wind turbines contract. We also collected information about where on the island the survey was administered, who administered the survey and the date the survey was administered (Table 7).

Fig. 1. Visualization seen by respondents.

Fig. 2. Aerial view and coordinates of vantage location.

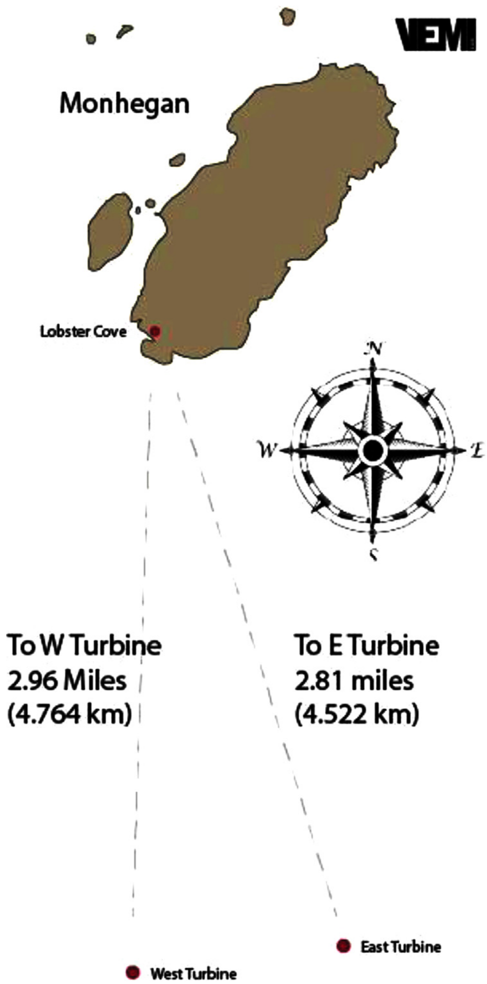

Fig. 3. Location of turbines relative to visual vantage location.

4.3. Empirical analysis

Random assignment of information treatment across subjects, and consistent survey administration, are important to determine effect of treatments, but may be challenging to accomplish in field experiments. If pre-experiment or survey administration differences exist between our two information treatment groups (VR, SP) then differences in our dependent variables (RXNs) could be impacted by these sample differences. As a result, we first analyze the data performing a combination of inferential statistics (cross-tab analysis and ANOVA) to determine if there are differences in responses given *before* the visualization (Tables 1–3), the respondent demographics (Table 6) and the survey administration characteristics (Table 7). We do find one difference in trip characteristics (Table 1: respondents viewing the SP took more multi-day trips per year, on average, than those viewing the VR), and several differences across the samples with respect to the importance they put on various reasons to visit Monhegan (Table 2). Those viewing the VR placed more importance on the authentic Maine experience, the abundance of wildlife and the birds, and wildlife watching available. We also find one difference in respondents pre-existing views on where wind turbines should be located (Table 3: those viewing the SP were less likely to disagree that windfarms should be kept away from special scenic areas than those viewing the VR). We find no difference across samples in the respondents' demographic characteristics (Table 6), and no difference across samples in where the survey was administered and who administered the survey (Table 7). However, we do find a difference across samples in the date the data were collected; on average, more static photos where used later in the survey period.

Because we find these differences across samples, further analyses use regression techniques which should include all of the above variables to control for sampling-related differences. However, we were unable to include an independent variable to account for respondents' agreement that wind turbines should be away from special scenic areas because only one person in the SP sample stated they disagree or strongly disagree with this view. As a result, the regressions suffer from quasi-separation which means a unique maximum likelihood estimate does not exist (SAS Knowledge Base, 2016). One solution is to further collapse the categories; however, if we collapse the disagree/strongly disagree categories with the neutral category then the response distributions are not different ($\chi^2 = 0.03$ $p = 0.85$).

As a result, our general empirical model[7] becomes:

$$RXN = \alpha + \beta_1 ABUND + \beta_2 AUTH + \beta_3 BIRD + \beta_4 TRIP + \beta_5 DATE + \beta_6 VERSION + \varepsilon$$

where RXN denotes the responses given to the 12 different questions asked *after* the respondents viewed the visualization (Tables 4, 5). However, we assume some of these dependent variables (DVs) will be highly correlated so we use factor and reliability analysis as a data reduction technique to test whether groups of dependent variables have common underlying dimensions and can be considered to measure a common construct.

Our analyses of the DVs begin by grouping variables by their response structure (ordered, binary). Seven of the ordered dependent variables in Table 4 are analyzed using factor analysis (Table 8). As is typical, factors with Eigen values less than one are dropped from further analysis as are variables with factor loadings of less than 0.7 as these are not considered statistically significant for interpretation purposes. We find four DVs load on factor 1, one loads on factor 2, one loads on factor 3 and one does not load strongly on any of the factors. To further verify the reliability of the factor analysis we compute Cronbach's alpha on the original responses; aiming to have alphas greater than the minimum value of 0.70 (Nunnally and Bernstein, 1994). We find the four items loading on factor 1 can be summarized as an index[8] (named REDUCE in Tables 8, 9). The other factor analysis variables will stand alone as dependent variables, as they are not highly correlated. Testing other potential indices indicate we can only construct an index (named VISIT) out of two other DVs (Table 8). Both indices have positive correlations across the index variables. Hence, higher REDUCE scores indicate a higher perception the tourist experience is degraded while higher VISIT scores indicate a lower level of visitation. The end result is we have reduced our 12 dependent variables down to eight, which are not highly correlated.

The independent variables ABUND, AUTH and BIRD are control variables denoting the importance respondents placed on the following reasons to visit Monhegan: 'abundant wildlife', 'authentic Maine experience' and 'bird/wildlife watching'. TRIP is also a control variable denoting the respondent's stated number of multi-day trips per year. DATE denotes the number of days the survey was administered relative to the start of the survey period. VERSION is the variable of interest because it identifies if the dependent variable is significantly different across the two visualization treatments (where VERSION = 1 if the respondent saw a static photo, 0 if they saw a virtual reality rendering). Hence, all of our independent variables either: occurred *before* the visual (ABUND, AUTH, BIRD, TRIP), were not part of the survey itself (DATE when the survey was administered) or was the treatment

[7] Unfortunately, we did not ask visitors if they currently reside near wind turbines, where research has shown mixed results in reactions to visual aesthetics (Krause et al., 2016; Ladenburg and Lutzeyer, 2012; Latré et al., 2017).

[8] Indices are constructed by creating an average response from the individual variables.

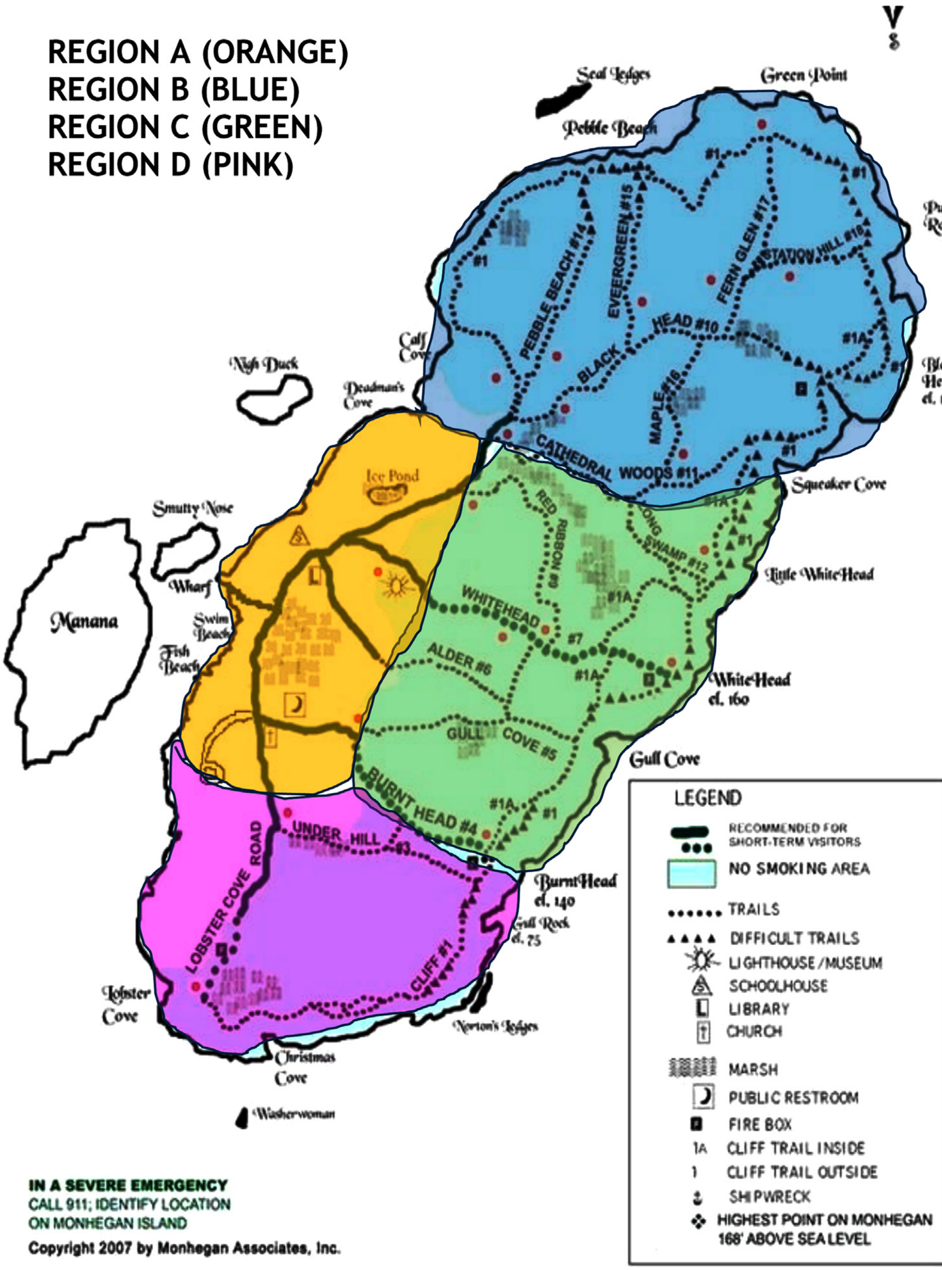

Fig. 4. Monhegan Island map.

(VERSION). All dependent variables (RXN) were collected *after* the treatment. ε is the error term. Estimation for ordered and binary DVs is logistic regression; continuous indices are estimated with least-squares regression.

Although we find differences in some of the independent variables across the two versions, there is no *a priori* reason to believe these variables significantly effect RXN. As such we run three versions of the models: 1) models with all the independent variables without VERSION, 2) models with all the independent variables and VERSION and 3) reduced models with only the significant independent variables and VERSION. Appendix C provides the estimation results for the two full model variations, Table 9 provides goodness-of-fit statistics for all three model variations and Table 10 provides the final, reduced model. Given the reduced model removes control variables, the number of observations per model increases; to make a clean comparison of the three models we restrict the observations in the reduced model to be consistent with the other 'full' models. We compare the goodness-of-fit statistics across the two 'full' models (logit models compares AICs[9]; OLS compares F-stat and R^2) to test whether adding VERSION to the full model improves the fit. We then compare both of the full models to the reduced models, to test whether dropping insignificant control variables improves model fit.

5. Results and discussion

5.1. Descriptive statistics: dependent variables

In general, there were three trends created by the VR version: 1)

[9] The rule of thumb for AICs is a 2 or more reduction in the AIC indicates a significant improvement in the model (https://www.researchgate.net/post/Model_selection_by_The_Akaikes_Information_Criterion_AIC_what_is_common_practice; https://stats.stackexchange.com/questions/8557/testing-the-difference-in-aic-of-two-non-nested-models).

Table 2
Importance of various reasons for visiting Monhegan (percent stating) by survey version.[a,b]

	Static photo			Virtual landscape			χ^2 statistic; p-value
	Not important	Somewhat important	Very important	Not important	Somewhat important	Very important	
Beautiful scenery	1	5	94	0	3	97	1.34; 0.51
Pristine ocean views	2	5	93	0	11	89	3.79; 0.15
Good place to relax and get away from it all	1	8	91	0	15	85	2.66; 0.26
Unspoiled environment	1	13	86	0	14	86	0.97; 0.61
Peace and Quiet	2	16	82	0	21	79	2.36; 0.31
Good for outdoor activities	5	18	77	6	19	76	0.10; 0.94
Authentic Maine experience	**6**	**32**	**62**	**1**	**20**	**78**	5.73; 0.06
Quaint village/lighthouse	7	34	59	4	24	72	2.72; 0.26
Good for families	16	27	57	26	28	46	2.67; 0.26
Recreation	19	29	52	18	23	59	0.95; 0.62
Abundant wildlife	**17**	**47**	**36**	**12**	**33**	**55**	5.62; 0.06
Bird/wildlife watching	**23**	**54**	**33**	**12**	**43**	**45**	4.54; 0.10

[a] **BOLD** indicates a significant difference across survey version, at the 10% level.
[b] Percents may not sum to 100 due to rounding.

Table 3
Visitors agreement with statements of where wind turbines should be located (percent stating) by survey version.[a,b]

	Static photo			Virtual landscape			χ^2 statistic;
	Agree	Neutral	Disagree	Agree	Neutral	Disagree	p-value
Away from special scenic areas[c]	**79**	**19**	**2**	**78**	**10**	**12**	8.13; 0.02
Far out at sea	66	21	13	66	20	14	0.04; 0.99
In remote, rural areas	67	16	17	60	19	21	1.07; 0.58
Away from people and wildlife	58	31	12	65	21	14	2.13; 0.34
Near town/Developed areas	42	25	33	35	22	44	2.21; 0.22
Near the coast	34	34	33	40	24	36	1.83; 0.40
Nowhere at all	14	15	72	6	18	76	2.54; 0.28

[a] **BOLD** indicates a significant difference across survey version, at the 10% level.
[b] Percents may not sum to 100 due to rounding.
[c] Due to low response numbers in the 'disagree' option under the static photo version this variable was unstable resulting in quasi-separation. Thus, we were unable to include it in our regression analysis.

Table 4
Visitor agreement with possible reactions to the wind farm (percent stating) by survey version.[a,b]

	Static photo			Virtual landscape			χ^2 statistic; p-value
	Agree	Neutral	Disagree	Agree	Neutral	Disagree	
Virtual landscape trends toward more disagreement							
I don't have enough information to evaluate the impact on Monhegan from the turbines	**56**	**24**	**20**	**41**	**21**	**38**	7.08; 0.03
I feel a lot of uncertainty about the impact of the turbines on Monhegan	48	24	27	43	18	39	2.98; 0.22
Wind turbines near Monhegan would appeal to visitors	19	27	54	17	19	64	2.11; 0.35
Virtual landscape trends toward more agreement							
Wind turbines spoil the look of Monhegan	24	26	50	38	21	41	3.92; 0.14
I am concerned about the impact of the turbines on recreation	20	22	58	32	19	49	3.28; 0.19
Fewer visitors will come to Monhegan because of the turbines	21	19	60	23	27	50	2.06; 0.36
I will avoid Monhegan if wind turbines are nearby	**4**	**5**	**91**	**12**	**16**	**72**	9.90; 0.007
Virtual landscape trends away from neutral toward both directions[c]							
I am concerned about the impact on peace & quiet	**33**	**27**	**40**	**44**	**9**	**47**	9.51; 0.009
Seeing wind turbines would add to my enjoyment of Monhegan	**12**	**33**	**56**	**19**	**18**	**63**	5.58; 0.06

[a] BOLD indicates a significant difference across survey version, at the 10% level.
[b] Percents may not sum to 100 due to rounding.
[c] Given the movement is from the middle to the extreme categories, we recoded these two dependent variables as 1 = either agree or disagree, 0 = neutral.

movement away from 'neutral' responses to RXNs towards both extremes, supporting H3c (Table 4), 2) the VR version generally led to more negative reactions toward the wind turbines (e.g., spoils the look of Monhegan), supporting H2 but, 3) more positive reactions to the information environment (e.g., have adequate information, supporting H3a, and lower levels of uncertainty, supporting H3a). In most cases, the VR version caused a general reduction in the percent saying 'neutral'; however, in two cases ('Seeing wind turbines would add to my enjoyment' and 'I am concerned about the impact on peace and quiet') the movement away from neutral was significant toward both extremes, supporting H1.

We assume people choosing the center (neutral) are those that have either well-formed neutral opinions (indifference), or have loosely-formed opinions (undecided/no opinion) about windfarms due to a lack

Table 5
Visitor evaluation of how a wind farm will affect their Monhegan experience and visitation (percent stating) by survey version.[a]

	Static photo	Virtual landscape	X^2 statistic; p-value
How Will Wind Turbines Affect your Visiting Experience?[b]			
Enhances the experience (n = 11)	**5**	**8**	7.60; 0.02
Neither enhances nor detracts from the experience (n = 118)	**78**	**59**	
Detracts from the experience (n = 40)	**16**	**33**	
Would they affect your frequency of visits to the island?[b]			
I would no longer visit Monhegan	**0**	**2**	7.30; 0.06
I would come less often	**4**	**12**	
No change in number of visits per year	**94**	**81**	
I would come more often	**2**	**5**	
Would they affect where you go on the island?[c]			
They would not change where I traveled	72	66	0.83; 0.36

[a] **BOLD** indicates a significant difference across survey version, at the 10% level.
[b] Percents may not sum to 100 due to rounding.
[c] Percents may not sum to 100 since multiple categories could be chosen.

Table 6
Characteristics of the surveyed visitors by survey version.

	Static photo	Virtual landscape	Test statistic; p-value[b]
Gender (percent male)	53	48	0.35; 0.55
Average age (years)	48	48	− 0.04; 0.96
Percent stating they are a Maine resident	24	24	0.11; 0.92
Education (percent stating)[a]			
12th grade or less	1	2	1.29; 0.86
Graduated high school or equivalent	5	6	
1–3 years of college, no degree	13	12	
Graduated college (Bachelor's degree or equivalent)	37	41	
Post-graduate degree (Master's, Doctorate, Law or other)	44	38	
Household income	$132,200	$126,300	− 0.37; 0.72

[a] Percents may not sum to 100 due to rounding.
[b] Statistics reported are chi-square results, except age and income which are *t*-test statistics.

their opinions in either direction). As a quick test, we compared the distributions of responses to these two questions (QUIET and ENJOY), among those who had prior knowledge of the proposed project, versus those who don't have this knowledge. We find that among the uninformed group, the distribution of responses are significantly different between the VR and SP (QUIET: x^2 = 7.85, p = 0.005; ENJOY: x^2 = 2.81, p = 0.093) while among the informed group the distribution of responses were the same between the VR and SP (QUIET: x^2 = 1.61, p = 0.20; ENJOY: x^2 = 1.54, p = 0.21). This would be consistent with our assumption above. This would suggest the VR helped people explore and solidify their perceptions of, or preferences toward, the turbines. Given the movement is from the middle to the extreme categories, we recoded these two dependent variables for the regression analysis as 1 = either agree or disagree, 0 = neutral.

Movement away from a middle category is also seen when we asked how the wind turbines would affect their visitation habits and experience (Table 5). For example, those seeing the VR version were less likely to state the turbines would have no impact on the quality of their experience and more likely to state the turbines would either enhance or detract from the experience. Similarly, when asked about visitation frequency, the VR respondents were less likely to say 'no change' and more likely to say either more or less frequently. In general, the VR responses were more likely to be negative (e.g., larger percent increase in those saying 'detracts' relative to those who saying 'enhances').

5.2. Regression results

When we compare the goodness-of-fit statistics across the two 'full' models we find of the six logit models, four are strongly improved, one is marginally improved and one is marginally degraded, and the two OLS models both improve (Table 9). When we compare the full models with the reduced models, we find all the model fits improve by dropping insignificant controls (Table 9).

The coefficients on the treatment variable, VERSION, is significant in seven of the eight regressions (Table 10). Individuals who saw the VR version were more likely to disagree that: they lack information, they felt higher levels of uncertainty and turbines will appeal to visitors. They also held relatively more negative views (REDUCE). For two of the equations (QUIET and ENJOY), we find the VR viewers moved from a neutral position to a more extreme position, relative to those seeing a SP. We also find those responding to the VR were less likely to perceive the windfarm as enhancing their experience, leading them, on average, to reduce their visitation (VISIT).

Table 7
Location on island where survey was administered,[a] who administered the survey and date survey was collected.

	Static photo	Virtual landscape	Test statistic
Region A – Monhegan village and boat landing	89%	89%	χ^2 = 1.54; p = 0.81
Region B – Monhegan's north shore	2	1	
Region C – Monhegan's east shore	2	3	
Region D – Monhegan's south shore	7	5	
Percent survey administered by surveyor 1	53	50	χ^2 = 0.17; p = 0.67
Average number of days from the initial survey date	**94**	**74**	t = − 4.43; p = 0.0001

[a] Refer to Fig. 4.

of experience with, or information about such farms.[10] We assume the people in the first group are less likely to change their opinions but those in the second group are more likely to move away from the center when the information is new, different and salient (i.e., they update

[10] We acknowledge this lack of pre-experiment information may be due to a lack of salience of the topic due to geographical and psychological distance (Clarke et al., 2016) and/or limited cues from external sources (Gravelle and Lachapelle, 2015).

6. Conclusions

Increased interest in wind energy yields a challenging tradeoff between consumer demand for renewable energy and the external costs associated with these production methods. An essential part of our transition to renewable energy is balancing these various opportunities and conflicts; in order to do so we must improve our knowledge of the tradeoffs. This study examined the role of novel information provision, in the form of virtual reality, in tourist acceptance of offshore

Table 8
Summary of factor and reliability analyses.

	Factor 1	Factor 2	Factor 3
Factor analysis			
I am concerned about the impact of the turbines on RECreation	**0.789**	-.-	-.-
I will AVOID Monhegan if wind turbines are nearby	**0.746**	**-.-**	− 0.330
Wind turbines SPOIL the look of Monhegan	**0.746**	**-.-**	0.416
FEWER visitors will come to Monhegan because of the turbines	**0.712**	**-.-**	-.-
I feel a lot of UNCertainty about the impact of the turbines on Monhegan	− 0.641	0.595	-.-
I don't have enough INFOrmation to evaluate the impact on Monhegan from the turbines	-.-	0.895	-.-
Wind turbines near Monhegan would APPEAL to visitors	-.-	-.-	0.885
Reliability analysis			Cronbach's alpha
REDUCE INDEX (RECreation + AVOID + SPOIL + FEWER)/4			0.76
VISIT INDEX (How will wind turbines affect your visiting EXPerience? + Would they affect your FREQuency of visits to the island?)/2			0.70
Other possibilities rejected			
I am concerned about the impact on peace & QUIET; Seeing wind turbines would add to my ENJOYment of Monhegan			0.44
APPEAL; ENJOY			0.51
INFO; UNC			0.50
EXP; FREQ?; Would they affect WHERE you go on the island?			0.52

Table 9
Goodness-of-fit comparison across models; each model permutation holds the number of observations constant[a] .

	INFO	UNC	APPEAL	REDUCE INDEX	QUIET	ENJOY	VISIT INDEX	WHERE
Permutation 1								
Full without VERSION								
AIC	329.0	330.0	304.9		141.2	177.6		185.0
F				2.77**			0.58	
Adjusted R^2				0.06			− 0.014	
Permutation 2								
Full with VERSION								
AIC	326.1	327.6	299.4		139.4	173.1		186.7
F				3.08*			1.02	
Adjusted R^2				0.08			0.001	
Coefficient on VERSION	0.758**	0.707**	0.973***	0.421**	0.972*	1.072**	− 0.121*	0.182
Permutation 3								
Reduced with VERSION								
AIC	**319.2**	**323.9**	**294.6**		**135.3**	**170.3**		181.6
F				**6.13*** **			**3.08*** **	
Adjusted R^2				**0.06**			**0.01**	
Coefficient on VERSION	**0.700** **	**0.584** *	**0.736** **	**0.425** **	**0.881** *	**1.168** ***	− 0.108*	0.110
Number of observations	153	154	154	150	154	154	150	156

* Significant at $p < 0.10$.
** Significant at $p < 0.05$.
*** Significant at $p < 0.01$.
[a] Smaller AICs and larger F and R^2 statistics indicate a better model fit to the data.

windfarms and how those perceptions of windfarms can affect tourists' visitation decisions. We observed that participants given the virtual rendering, therefore more information, felt better prepared to make evaluations about the impact of wind turbines on their visitation experience and provide better forecasts of how their behavior may change. In contrast, those who were given the 2-D picture were less confident in their answers (as indicated by a higher stated level of uncertainty, and higher levels of 'neutral' responses). Another consistent theme is the VR technology caused respondents, on average, to have more negative reactions to the wind turbines (although a small subset of respondents had more positive views).

Given the placement of the horizon and the overall composition of a visualization can affect preferences (Svobodova et al., 2014) differences in reactions to the two visuals may be driven by seeing the turbines at different angles (i.e., not driven by differences between the static and dynamic turbines). It is not clear those viewing the VR would be biased in a specific direction; in fact, it seems more likely the VR version's data would have increased variance relative to the static photo data. This would suggest any differences we find may lie on the conservative side – that is, if we had more granular data on how respondents viewed the VR we might have found even stronger differences.

Participants in the VR condition were able to manipulate their experience and engage with the environment by turning to view different areas available in the VR but not in the SP. With the VR scenario, participants may have incorporated more information about the area in creating their mental representation. However, due to the nature of the survey,[11] we were unable to test the mechanism that influences these mental representations. Although we did not systematically capture participant's engagement with the VR,[12] we anticipate increased engagement may *decrease* their psychological distance (PD) from the wind turbines.

Our study also did not capture visitors' perceptions on whether their preferences would impact the wind turbine siting decision; however, the role of power (or perceived power) is a proposed new component of

[11] Given this was an intercept survey of visitors, most of whom would have a limited time due to the ferry schedule, we dropped many questions to shorten the survey. We also had a secondary concern that the intercept nature of the survey could also reduce completion of more sensitive questions, e.g., asking a person's ideologies.

[12] We did not track respondent's engagement with the visuals; however, our surveyors noted the VR seemed to lead to more engagement as they looked around to find the wind turbines, and the area they were 'virtually' standing in (on a hiking trail just above a beach area at the southern end of the island).

Table 10
Final regression results.

	INFO[a]	UNC[a]	APPEAL[a]	REDUCE[b] INDEX	QUIET[c]	ENJOY[c]	VISIT[b] INDEX	WHERE[d]
Intercept1	− 0.452**	0.002	− 1.742***	3.275***	− 2.846***	− 1.509***	2.171***	− 0.519
	0.223	*0.290*	*0.268*	*0.167*	*0.481*	*0.420*	0.043	0.418
Intercept2	0.5672**	0.966***	− 0.5472**					
	0.226	*0.299*	*0.232*					
Abundant wildlife				0.4422**		− 0.8782**		
				0.190		*0.441*		
Authentic Maine experience						− 1.399***		
						0.512		
Bird watching		− 0.894***				0.9392**		1.038***
		0.321				*0.467*		0.371
Annual multiday trips					0.896^{*8*}			1.0582**
					0.338			0.463
Date survey taken								
Version	0.7512**	0.6092**	0.387	0.3982**	0.936*	1.179***	− 0.111*	0.140
	0.293	*0.307*	*0.303*	*0.189*	*0.483*	*0.413*	0.060	0.371
AIC	353	333	336		137	171		183
F; Adjusted R^2				5.69***; 0.06			3.46***; 0.02	
Number of observations	170	158	172	153	156	157	167	157

INFO	I don't have enough information to evaluate the impact on Monhegan from the turbines
UNC	I feel a lot of uncertainty about the impact of the turbines on Monhegan
APPEAL	Wind turbines near Monhegan would appeal to visitors
REDUCE INDEX	Wind turbines spoil the look of Monhegan
	I am concerned about the impact of the turbines on recreation
	Fewer visitors will come to Monhegan because of the turbines
	I will avoid Monhegan if wind turbines are nearby
QUIET	I am concerned about the impact on peace and quiet
ENJOY	Seeing wind turbines would add to my enjoyment of Monhegan
VISIT INDEX	How Will Wind Turbines Affect your Visiting Experience?
	Would they affect your frequency of visits to the island?
WHERE	Would they affect where you go on the island?

[a] Dependent Variables: 1 = agree, 3 = neutral, 5 = disagree.
[b] Indices defined in Table 8.
[c] Given the movement is from the middle to the extreme categories, we recoded these two dependent variables as 1 = either agree or disagree, 0 = neutral.
[d] Dependent Variable: 1 = yes, 0 = no.
* Denotes significant at $p < 0.10$.
** Denotes significant at $p < 0.05$.
*** Denotes significant at $p < 0.01$.

PD in energy decision-making (Geng et al., 2018). Unfortunately, our survey design was unable to directly capture how participants' PDs changed with the VR or SP experience; we encourage future researchers to consider pursuit of these issues in future visualization efforts.

Our work provides an important consideration for design and implementation of policy and future research surrounding wind energy acceptance. VR technology can significantly improve data quality when seeking respondent reactions to potential structures 1) having visible moving components, and 2) sited in a scenic landscape. While projects will be evaluated differently by different people in different settings, use of the VR technology may provide more consistent and accurate information. Improved understanding of the factors influencing acceptance of wind energy, including specific aesthetic concerns may help policy makers communicate wind development options to residents and visitors alike.

Acknowledgments

We thank the stakeholders, collaborators, and colleagues who helped design the survey and selection of our site, the students who administered the surveys (D. Bouchard and B. Teisl) as well as the VEMI staff who designed and developed the virtual simulations. Lastly, we thank the people of Monhegan Island for supporting our research and to the visitors for participating.

Funding source

This research was conducted with funding from The National Science Foundation award EPS-09041552 to Maine EPSCoR at The University of Maine (USA). Support was also provided by the Senator George J. Mitchell Center for Sustainability Solutions at the University of Maine (USA), and the Maine Agricultural and Forest Experiment Station at the University of Maine (USA) #ME021510 and #ME021923. None of the funding sources had input into the design or implementation of the research, nor in the writing.

Competing interests

The authors have no competing financial or personal interests related to the subject of this paper.

Human subjects

The University of Maine's Institutional Review Board for the Protection of Human Subjects reviewed and approved: the design of the survey instrument and administration protocols, data confidentially and storage protocols and the informed consent and privacy information provided to survey respondents.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.enpol.2018.08.018.

References

Abromas, J., Kamičaitytė-Virbašienė, J., Ziemeļniece, A., 2015. Visual impact assessment of wind turbines and their farms on landscape of Kretinga region (Lithuania) and Grobina townscape (Latvia). J. Environ. Eng. Landsc. Manag. 23 (1), 39–49.

Albrecht, C., Wagner, A., Wesselmann, K., Korb, M., 2013. The impact of offshore wind energy on tourism. Available at: 〈http://www.offshore-stiftung.com/60005/Uploaded/Offshore_Stiftung%7C2013_04SBO_SOW_tourism_study_final_web.pdf〉.

Betakova, V., Vojar, J., Sklenicka, P., 2015. Wind turbines location: how many and how far? Appl. Energy 151, 23–31.

Bishop, I.D., Miller, D.R., 2007. Visual assessment of off-shore wind turbines: the influence of distance, contrast, movement & social variables. Renew. Energy 32, 814–831.

Bishop, I.D., Stock, C., 2010. Using collaborative virtual environments to plan wind energy installations. Renew. Energy 35 (10), 2348–2355.

Braunová, V., 2013. Impact Study of Wind Power on Tourism on Gotland (M.Sc. in Wind Power Project Management). Uppsala University, Visby, Sweden(Available at: 〈http://cvi.se/uploads/pdf/Aktuellt/Braunova_thesis_summary.pdf〉).

Broekel, T., Alfken, C., 2015. Gone with the wind? The impact of wind turbines on tourism demand. Energy Policy 86, 506–519.

Business, L.F., Damsbo-Andersen, L., 2013. Wind Turbines & Tourism Potentials in Guldborgsund Municipality: Part of the Interregiva Project South Baltic Offshore Energy Regions. (Available at: 〈http://www.southbaltic-offshore.eu/reports-studies/img/offshore_wind_windturbines_and_tourism.pdf〉).

Chias, P., Abad, T., 2013. Windfarms: GIS-based visual impact assessment and visualization tools. Cartogr. Geogr. Inf. Sci. 40 (3), 229–237.

Clarke, C.E., Bugden, D., Hart, P.S., Stedman, R.C., Jacquet, J.B., Evensen, D.T., Boudet, H.S., 2016. How geographic distance and political ideology interact to influence public perception of unconventional oil/natural gas development. Energy Policy 97, 301–309.

Devine-Wright, P., 2005. Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. Wind Energy 8, 125–139.

Devlin, E., 2005. Factors affecting public acceptance of wind turbines in Sweden. Wind Eng. 29 (6), 503–511.

Eltham, D.C., Harrison, G.P., Allen, S.J., 2008. Change in public attitudes towards a Cornish windfarm: implications for planning. Energy Policy 36 (1), 23–33.

Fáilte Ireland, 2012. Visitor attitudes on the environment – wind turbines 2008/No. 3, 1/31/2012. Available at: 〈http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/Visitor-Attitudes-on-the-Environment.pdf?ext=.pdf〉.

Fergen, J., Jacquet, J.B., 2016. Beauty in motion: expectations, attitudes, and values of wind energy development in the rural US. Energy Res. Social Sci. 11, 133–141.

Filova, L., Vojar, J., Svobodova, K., Sklenicka, P., 2015. The effect of landscape type and landscape elements on public visual preferences: ways to use knowledge in the context of landscape planning. J. Environ. Plan. Manag. 58 (11), 2037–2055.

Firestone, J., Bidwell, D., Gardner, M., Knapp, L., 2018. Wind in the sails or choppy seas?: people-place relations, aesthetics and public support for the United States' first offshore wind project. Energy Res. Social Sci. 40, 232–243.

Fooks, J.R., Messer, K.D., Duke, J.M., Johnson, J.B., Parsons, G.R., 2017. Continuous attribute values in a simulation environment: offshore energy production and Mid-Atlantic beach visitation. Energy Policy 110, 288–302.

Franconeri, S., Simons, D., 2003. Moving and looming stimuli capture attention. Percept. Psychophys. 65 (7), 999–1010.

Frantál, B., Kunc, J., 2011. Wind turbines in tourism landscapes. Ann. Tour. Res. 38 (2), 499–519.

Frantál, B., Urbánková, R., 2014. Energy tourism: an emerging field of study. Curr. Issues Tour. 1–18.

Fujita, K., Henderson, M.D., Eng, J., Trope, Y., Liberman, N., 2006. Spatial distance and mental construal of social events. Psychol. Sci. 17 (4), 278–282.

Gee, K., 2010. Offshore wind power development as affected by seascape values on the German North Sea coast. Land Use Policy 27 (2), 185–194.

Geng, L., Liu, T., Zhou, K., Yang, G., 2018. Can power affect environmental risk attitude toward nuclear energy? Energy Policy 113, 87–93.

Georgiou, I., Areal, F.J., 2015. Economic valuation of an offshore windfarm in Greece: the role of individuals' base-state influences and beliefs in the value formation process. Renew. Sustain. Energy Rev. 52, 717–724.

Gravelle, T.B., Lachapelle, E., 2015. Politics, proximity and the pipeline: mapping public attitudes toward Keystone XL. Energy Policy 83, 99–108.

Heft, H., Nasar, J.L., 2000. Evaluating environmental scenes using dynamic versus static displays. Environ. Behav. 32 (3), 301–322.

Hetherington, J., Daniel, T.C., Brown, T.C., 1993. Is motion more important than it sounds?: the medium of presentation in environment perception research. J. Environ. Psychol. 13 (4), 283–291.

Hevia-Koch, P., Ladenburg, J., 2016. Estimating preferences for wind turbine locations – a critical review of visualisation approaches. Available at: 〈https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2848529〉.

Huff, E.S., Leahy, J.E., Kittredge, D.B., Noblet, C.L., Weiskittel, A.R., 2017. Psychological distance of timber harvesting for private woodland owners. For. Policy Econ. 81, 48–56.

Jallouli, J., Moreau, G., 2009. An immersive path-based study of wind turbines' landscape: a French case in Plouguin. Renew. Energy 34 (3), 597–607.

Kaplan, R., Kaplan, S., 1989. The Experience of Nature: A Psychological Perspective. Cambridge University Press, Cambridge; New York.

Knapp, L., Li, Y., Ma, Y., Rife, M., 2013. An Analysis of Offshore Wind Development: A Non-market, Stated-Preference Approach to Measure Community Perceptions and Opinions and Estimate Willingness to Pay in Two Michigan Regions (Master's thesis).

Krause, R.M., Pierce, J.C., Steel, B.S., 2016. The impact of auditory and visual experience with wind turbines on support for wind production and Pproximity-based opposition. Soc. Nat. Resour. 1–15.

Ladenburg, J., Lutzeyer, S., 2012. The economics of visual disamenity reductions of offshore windfarms—review and suggestions from an emerging field. Renew. Sustain. Energy Rev. 16 (9), 6793–6802.

Ladenburg, J., 2010. Attitudes towards wind turbines—the role of beach visits on attitude & demographic & attitude relations. Energy Policy 38, 1297–1304.

Ladenburg, J., 2009. Visual impact assessment of offshore windfarms and prior experience. Appl. Energy 86 (3), 380–387.

Landry, C.E., Allen, T., Cherry, T., Whitehead, J.C., 2012. Wind turbines & coastal recreation demand. Resour. Energy Econ. 34 (1), 93–111.

Latré, E., Perko, T., Thijssen, P., 2017. Public opinion change after the Fukushima nuclear accident: the role of national context revisited. Energy Policy 104, 124–133.

Lilley, M.B., Firestone, J., Kempton, W., 2010. The effect of wind power installations on coastal tourism. Energies 3 (1), 1–22.

Lutzeyer, S., Phaneuf, D.J., Taylor, L., 2016. The Amenity Cost of Offshore Windfarms: Evidence from a Choice Experiment. Available at: 〈https://cenrep.ncsu.edu/cenrep/wp-content/uploads/2016/03/LPT_Offshore-Wind-1.pdf〉.

MacKay, K.J., Fesenmaier, D.R., 1997. Pictorial element of destination in image formation. Ann. Tour. Res. 24 (3), 537–565.

Maslov, N., Claramunt, C., Wang, T., Tang, T., 2017. Method to estimate the visual impact of an offshore windfarm. Appl. Energy 204, 1422–1430.

Mirasgedis, S., Tourkolias, C., Tzovla, E., Diakoulaki, D., 2014. Valuing the visual impact of windfarms: an application in South Evia, Greece. Renew. Sustain. Energy Rev. 39, 296–311.

Molnarova, K., Sklenicka, P., Stiborek, J., Svobodova, K., Salek, M., Brabec, E., 2012. Visual preferences for wind turbines: location, numbers and respondent characteristics. Appl. Energy 92, 269–278.

Nunnally, J.C., Bernstein, I.H., 1994. Psychometric Theory, 3rd ed. McGraw-Hill, New York.

Pasqualetti, M.J., Gipe, P., Righter, R.W. (Eds.), 2002. Wind Power in View: Energy Landscapes in a Crowded World. Academic press, San Diego, California, USA.

Phadke, R., 2010. Steel forests or smoke stacks: the politics of visualisation in the Cape Wind controversy. Environ. Polit. 19 (1), 1–20.

Ribe, R.G., Manyoky, M., Hayek, U.W., Pieren, R., Heutschi, K., Grêt-Regamey, A., 2018. Dissecting perceptions of wind energy projects: a laboratory experiment using high-quality audio-visual simulations to analyze experiential versus acceptability ratings and information effects. Landsc. Urban Plan. 169, 131–147.

Riddington, G., Harrison, T., McArthur, D., Gibson, H., Millar, K., 2008. The Economic Impacts of Wind Turbines on Scottish Tourism: A Report for the Scottish Government. (ISBN: 978 07559 70322, Available at: 〈http://www.scotland.gov.uk/Publications/2008/03/07113507/0〉).

SAS Knowledge Base, 2016. Usage Note 22599: understanding and correcting complete or quasi-complete separation problems. Available at: 〈http://support.sas.com/kb/22/599.html〉.

Spence, A., Poortinga, W., Pidgeon, N., 2012. The psychological distance of climate change. Risk Anal. 32 (6), 957–972.

Strazzera, E., Mura, M., Contu, D., 2012. Combining choice experiments with psychometric scales to assess the social acceptability of wind energy projects: a latent class approach. Energy Policy 48, 334–347.

Svobodova, K., Sklenicka, P., Molnarova, K., Vojar, J., 2014. Does the composition of landscape photographs affect visual preferences? The rule of the Golden Section and the position of the horizon. J. Environ. Psychol. 38, 143–152.

Svobodova, K., Sklenicka, P., Vojar, J., 2015. How does the representation rate of features in a landscape affect visual preferences? A case study from a post-mining landscape. Int. J. Min. Reclam. Environ. 29 (4), 266–276.

Tourism Research Centre, School of Business, University of PEI, 2008. Wind Energy Report: Views of Residents of PEI & Visitors to PEI. (Available at: 〈http://trc.upei.ca/sites/discoveryspace.upei.ca.trc/files/Wind_Energy_Report.pdf〉).

Trope, Y., Liberman, N., 2010. Construal-level theory of psychological distance. Psychol. Rev. 117 (2), 440.

Urry, J., 1992. The tourist gaze and the 'environment'. Theory Cult. Soc. 9 (3), 1–26.

WEC (World Energy Council), 2016. World Energy Resources: Wind 2016.

Westerberg, V., Jacobsen, J.B., Lifran, R., 2013. The case for wind turbines, artificial reefs & sustainable tourism in the French Mediterranean. Tour. Manag. 34, 172–183.

Wolsink, M., 2007. Wind power implementation: the nature of public attitudes: equity and fairness instead of "backyard motives. Renew. Sustain. Energy Rev. 11 (6), 1188–1207.

Wolsink, M., 2010. Near-shore wind power—protected seascapes, environmentalists' attitudes, and the technocratic planning perspective. Land Use Policy 27 (2), 195–203.