Energy Research & Social Science 71 (2021) 101833

Contents lists available at ScienceDirect

Energy Research & Social Science

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

What's love got to do with it? Understanding local cognitive and affective responses to wind power projects

Aaron Russell, Jeremy Firestone *

University of Delaware, 373 Harker ISE Lab, Newark, DE 19716, USA

A R T I C L E   I N F O

Keywords:
Onshore wind
Survey
Emotions
Perception
Attitudes

A B S T R A C T

Negative perceptions of renewable energy development can lead to protest, resulting in project delay or failure. Alternatively, good communication and sensitivity to community feelings are pathways to success. While literature referencing the social aspects of wind power siting have become widespread, analyses which include individuals' affect or emotional dimensions are rarer. Appreciation for emotional as well as cognitive perceptions is crucial for adequate understanding of not just consumptive or productive aspects of energy, but entire systems. We use a US national cross-sectional data set of 1705 individuals who live within 8 km of a wind turbine collected in a research project led by Lawrence Berkeley National Lab in a random probability-based phone, mail, and online survey in 2016. We hypothesize that individuals who moved-in prior to commencement of project construction will differ markedly from those who move in afterwards in terms of the cognitive and affective aspects of their attitude formation, and in particular, that negative emotions will be distinct. Variables include emotions such as pride, anger, and annoyance, perceptions of fit with the landscape, descriptions of the turbines as industrial and whether they added to or detracted from the community. We find affect is the stronger driver of attitude, but not merely by negative emotions. When we include both cognitive and affective variables, individual emotions are generally more predictive of attitude for pre-construction neighbors and cognitive variables such as wind being an effective means of climate mitigation and perception of property value change are stronger post-construction.

1. Introduction

Social perception is an established consideration in the process of energy planning and renewable energy policy. Negative perceptions of projects or development processes lead to various forms of protest which inevitably delay them and, in some cases, cause projects to fail while positive perceptions engender support. Methods for promoting good communication and understanding among developers, governments, and communities are pathways to success. In the United States, wind energy development has grown steadily over decades and, as technology has improved, its status as a formidable variant of utility-scale electricity generation has solidified. There are currently over 100 GW (GW) of land-based wind capacity in the U.S. making it the third largest source of generation capacity, eclipsing nuclear power [1].

Research on the growing presence of renewables, let alone wind turbines, in our lives is of paramount importance to policymakers and stakeholders whose goals include smoothly integrating policies and projects into communities. Studies abound in the form of individual or comparative case-studies, which though valuable in furthering appreciation of the complexities of social perception, may not provide results that can be extrapolated generally. For example, case studies of wind energy projects are often chosen based on unique characteristics like controversy [2,3], geography [4,5], or that they are newly constructed or under construction. Typical and established projects are therefore left out and, thus, the lessons they embody go unheard.

Further growth on one hand looks inevitable; on the other hand, there are both social and individual gaps between support for wind power generally, and support for local projects, which provides winds of caution [6]. In 2015, Lawrence Berkeley National Lab (LBNL) led a cross-sectional research project that collected survey data from neighbors of wind power projects throughout the United States, leading to a number of publications (e.g., Hoen, et al. [7]). We use this publicly-available dataset in a new way by focusing on the interplay between people's rational, cognitive perceptions and their emotional or affective responses to local projects. Specifically, we utilize affective variables both independently and in concert with other variables to compare and

* Corresponding author.
E-mail addresses: adruss@udel.edu (A. Russell), jf@udel.edu (J. Firestone).

https://doi.org/10.1016/j.erss.2020.101833
Received 24 June 2020; Received in revised form 15 October 2020; Accepted 23 October 2020
Available online 5 November 2020

contrast pre- and post-construction wind project neighbors and interpret our results within the psychological as well as social science literature.

2. Literature review

Literature regarding community perception of wind energy projects has become nuanced in its methodologies, framings, and conclusions [8]. Understanding perception is critically important in informing research regarding sociotechnical outcomes, which include support or opposition to projects (like a vote) and overall attitude (general disposition). Research into planning has also focused on fairness of process and the benefits of increasing overall public engagement [9,10]. These outcomes have often been pursued under the umbrella of 'acceptance' research [11] despite the term's potentially problematic suggestion of mere tolerance. In instances of established (meaning not newly constructed) energy developments, attitude may be more appropriate.

Studies of sustainable energy and climate change mitigation are often grounded in aspects of behavioral economics, sociology and social/environmental psychology with many authors bridging the gaps between. Such combinations are particularly important when studies are targeted towards scales ranging from the individual to the local, although wider scales have not been discounted, as evidenced by the conceptualization of global place attachments and identities in Devine-Wright et al. [12]. Further development under perception and evaluation research includes a range of place-based constructs developed within cognitive and behavioral psychology, which can engender place protective behavior [13]. A critical aspect of place-relatedness and energy siting involves the temporal element. Pasqualetti [4] notes immutability and imposition as two of the five 'common threads' of opposition to wind energy projects. In these, he is referring to an idea of landscape permanence inherent to one's understanding of place as well as feelings of marginalization. Indeed, populations are not static and people are free to move to or away from wind energy projects as they would for other community facets such as schools and parks. This phenomenon is called Tiebout sorting [14] when referring to people's movements being informed non-politically by shopping for services and attributes that maximize their personal utility. People who move to a community after construction of a local wind project experience a different relationship with the landscape and the project than those who moved earlier to the community.

In behavioral economics, aversion to loss and cognitive dissonance are two reasons described by Huijts et al. [15] for changes in evaluation of technology implementation. Loss aversion and the 'endowment effect' describe the gap between willingness-to-pay and willingness-to-accept in economic experiments [16] where losses are weighed more strongly than gains [17]. Cognitive dissonance is the state of having multiple cognitions that are inconsistent with one another and often triggers a reweighting of cognitions or the addition or subtraction of new ones [18]. Overall, individuals are often biased towards preserving the status quo when faced with evaluation of something new [16]. It may be because people often overestimate the negative feelings they will experience during a change [19]. Huijts et al. [15] find that these factors may actually lead to a more positive evaluation of low-carbon technology after implementation in their study of a hydrogen fueling station in the Netherlands.

While literature referencing the social aspects of renewable energy technology siting, especially that relying on place attachment, has become more widespread, analyses of the individualized psychological aspects of perception and judgement in cases of wind energy are rarer. The seminal literature on risk perception and energy development arose in great part due to nuclear power [20], which remains a prevalent focus of literature addressing socio-psychological determinants of technology acceptance [21]. As Wolsink notes, an appreciation of that literature is "crucial for our fundamental knowledge" [22 p.288].

Risk perception is described as a fundamental aspect of individual cost-benefit analysis, whereby people choose actions they perceive will result in beneficial outcomes [23]. This process is often framed, as with Tiebout sorting, through the assumptions inherent in traditional economic theory (i.e., perfectly informed actors, utility maximization, etc.) [24]. Additionally, research has been undertaken into the roles of emotion or affect in this process that shows those aspects significantly influence perception and are distinct from more rational processes [20,25,26]. Böhm and Phister [27] and Böhm [28] propose a model of risk evaluation based on consequentialist (end/results oriented) and deontological (ethics/process) evaluation where emotional reactions play a central role and are driven by perceptions of causation and impact. In their 2012 framework, Huijts et al. [29] similarly utilize aspects of Norm Activation Theory, the Theory of Planned Behavior, and hedonics to look at how cognition and affect work together to influence sustainable energy technologies. Specifically, they propose that both positive and negative affect along with rational evaluation influence attitudes. The framework further incorporates project implementation dimensions of trust and fairness (both distributive and procedural). Overall, knowledge of and experience with the renewable energy technology influences the other variables [29], as do the implications of a project on peoples' various values [30].

Authors often conceptualize "the dance of affect and reason" [31] under what are called dual-process models, whereby measures of cognition and affect are coordinated to explain overall intuition [26,32]. However, the appropriate construction and use of these models is still an active topic of discussion in psychology literature [33,34]. This may be due to the nuances of the relationship among behavior, cognition and affect which can be highly context-dependent. The cognitive and affective dualism is analogous to other dualisms including experiential/analytic, and abstract/concrete. Essentially, these terms refer to the processing of the object as perception and each has a role in deciding judgement or behavior. Slovic describes the affective way as "intuitive, fast, mostly automatic, and not very accessible to conscious awareness" and the cognitive way as the use of "algorithms and normative rules, such as probability calculus, formal logic, and risk assessment" [26 p.311]. Put more simply, it is the difference between thinking fast and slow [35]. Their interactive nature, with one often proceeding the other in guiding behavior, is a key concept in the way in which psychological underpinnings of energy system evaluations are interpreted [23].

While much of the current research involving energy acceptance can be described as cognitive in nature [11,22], there are also explicit approaches to analyze affect both independent of and in combination with cognition regarding renewables [36–39]. One approach to this, the use of affective imagery, has been used to assess correlations between public perceptions of energy systems and voting behavior [20] as well as local vs general acceptance [39]. Affective imagery utilizes word association to identify potential positive or negative perceptions of an object. It has been used in relation to wind energy by Cousse et al. [40], who find that there are important differences between mild and strong wind energy opponents in terms of affective evaluations of Swiss wind energy. Affect or emotion can be particularly difficult to distinguish at the margins, although there have been empirical attempts to clarify these questions [36,41–43]. Efforts have also been made to distinguish specific emotional responses such as 'fear' and 'hope' from the concept of affect, which may take on a simpler nature of being attracted to or repelled by an object [44]. In such cases, affect may be described as a "faint whisper of emotion" [26 p. 312]. Researchers have also relied on Cognitive

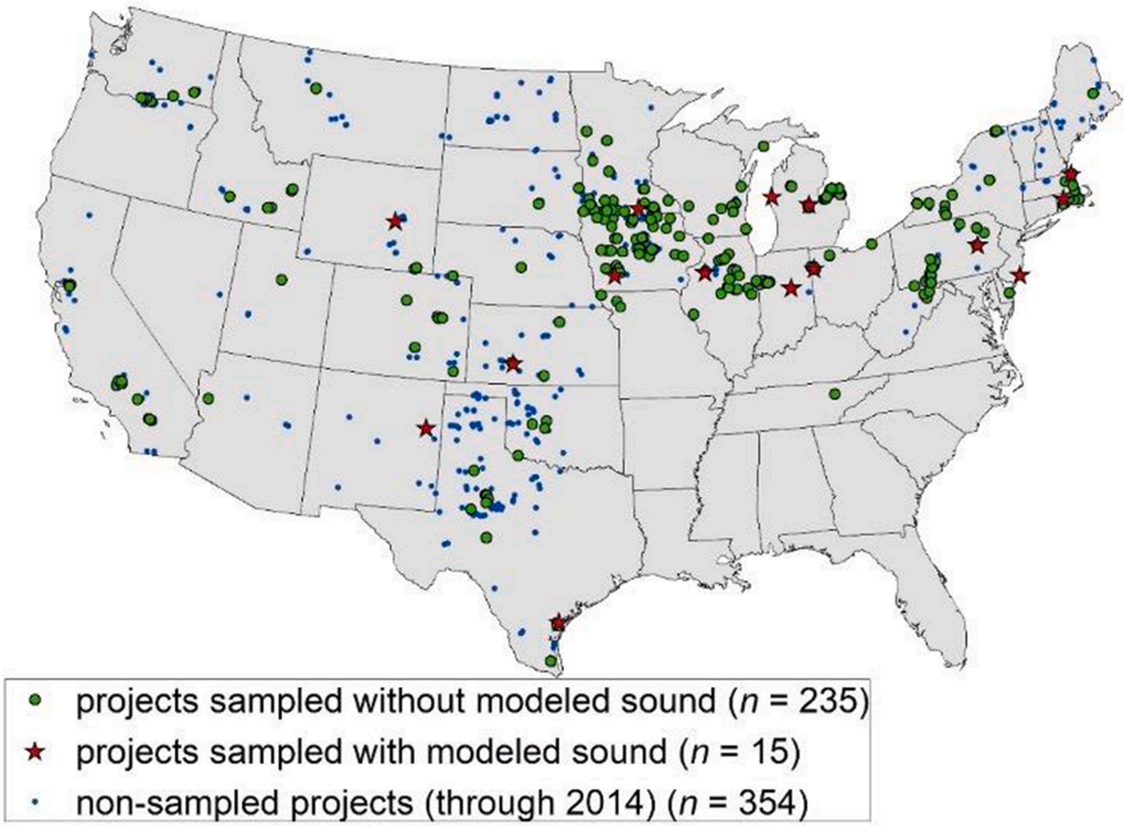

Fig. 1. Map of respondent and wind project locations. Adapted with permission from Hoen et al., (2019).

Appraisal Theory to study how discrete emotions like 'fear' and 'anger' are related to specific stimuli [45]. Some studies have relied on appraisal theory in the study of emotional evaluation of energy projects [46] and other technologies including mobile communications [47] to explain why and when certain emotions arise. In applying models based on a relationship between affect and cognition to energy systems, Rohse, Day, and Llewellin [44] posit that understanding emotional as well as cognitive perceptions is crucial for adequate understanding of not just consumptive or productive aspects of energy, but entire systems.

Using image evaluations, Truelove [39] finds that, out of models predicting support for coal, nuclear, natural gas, and wind power, only nuclear was more strongly predicted by affective elements than cognitive ones. That study, which focused on siting of and U.S. reliance more generally on different energy sources and had a relatively small sample size (n = 94), did not explain variance in wind support as well as other sources. Truelove attributes the lower explanatory power to the possibility that the model was perhaps picking up on positive perceptions of wind, especially in contrast the other three sources. The "individual gap" [6] describing the difference between general and specific acceptance may have played a part as well, as Truelove was not examining responses to specific projects, but rather hypothetical projects, with a locally-sited project to be one within 40 km. In a similarly focused survey project relying on a cognitive/affective model, Jobin and Siegrist [48] also find that affect has a high explanatory value for wind. Which of affective or cognitive elements have the stronger predictive power on different aspects of energy system perception could be instructive in communication of policies and energy project development proposals to the public.

Such insight can help to point to possible challenges in communication or policy measures. For example, the generally positive affect that people have for renewables may allow them to bypass any potential drawbacks until it is too late [38]. Moreover, when affect and cognition contradict each other, affect may dominate attitude formation [49]. Researchers and practitioners may be led astray if either is underconsidered in the study of people's perceptions. In particular, the trap is most likely two-fold. On one hand, emotional understanding may be avoided altogether [37]. On the other, it may be incomplete and lacking in attention to specific negative emotions or potential windfalls from positive affect in reaction to project development.

Given this literature, we investigate the relative roles that affect and cognition play in positive and negative attitudes towards support of local wind power projects in the United States. Our analysis is guided by two main research questions and two primary hypotheses.

Research Questions

- How do aspects of affect and cognition relate to wind project neighbors' attitudes about their local project?
- Do the pre- and post- construction project neighbors' attitudes differ in terms of their emotional and cognitive components and, if so, how?

Hypotheses

- Affective and cognitive aspects of local responses to a wind project differ measurably between those whose neighboring project was constructed after they moved in and those whose project was constructed prior.

- Pre-construction neighbors will be distinct from post-construction neighbors by the significance of affective variables and, in particular, negative affective variables.

3. Methods

LBNL led a 2015 random probability survey of individuals in the United States who live within 8 km (km) of a "utility scale" wind turbine. The researchers defined such a wind turbine as one with a nameplate capacity of at least 1.5 megawatts (MW) that was more than 111 m tall to the tip of a blade at its apex and installed prior to 2015 [7]. LBNL has made a de-identified version of the basic survey database available publicly on request, including to the authors [50].

The sample frame includes almost 1.3 million households adjacent to roughly 30,000 wind turbines at approximately 600 wind power projects (Fig. 1). LBNL stratified the sample by project size (large, more than ten turbines; small otherwise) and by distance, placing households in four distance bins, and oversampling those households within 0.8 km of a wind turbine. Several projects had large numbers of households proximate to them and were unsampled; other projects were oversampled to facilitate acoustic monitoring [51]. Human subjects review was undertaken by institutional review boards at three participating institutions.

LBNL drew a random, stratified probability sample. LBNL piloted the survey by telephone, evaluating whether the survey instrument could be comprehended by respondents and completed within a reasonable time. LBNL administered the final survey March-July 2016. Individuals were contacted by telephone, mail or both. Telephone contacts answered the survey orally over the telephone while mail contacts had the option of either a paper or online survey instrument. The surveys were identical other than changes necessitated by modal differences. Respondents were randomly drawn to receive one of four $500 gift cards. Survey protocols generally followed Dillman, Smyth, & Christian [52]. LBNL employed Voxco CATI and Qualtrics software, respectively, for the telephone and online surveys. LBNL received 1705 valid responses (effective response rate was 17.9%).

LBNL sought information on respondents' attitudes toward their local wind power project as mediated by landscape, sound and shadow flicker effects [3,39] and perceptions of the fairness of public processes [53], along with demographic information (gender, education, age, home ownership) and a respondent's relationship to the wind project (e.g., turbine host, moved-in prior to or after construction commenced). LBNL focused on respondents' attitudes toward the local wind project rather than their support of or opposition to or acceptance of that project, for reasons of clarity, because acceptance may imply tolerance, and in light of the time that had elapsed since the projects had become operational [53]. The survey instrument also sought information on emotions (e.g., pride, anger) engendered by the local wind project, descriptions of the wind turbines (e.g., attractiveness, fit with the landscape) and information regarding climate change (concern and whether wind power was an effective response). A copy of the survey is available at https://emp.lbl.gov/projects/wind-neighbor-survey. Further details on survey administration can be found in Hoen, et al. [7].

We provide summary descriptive data on the variable "attitude," primarily relying on Hoen, et al. [7], and a correlation matrix of the cognitive and affective variables. In addition, we present descriptive statistics of the variables (means/proportions and standard errors) in the regression samples and compare means/proportions between prior/subsequent subsamples. Analyses were conducted using Stata 15.

We undertake linear rather than ordered logistic regression. Given the five levels in the attitude variable and the small number of individuals assigned a value for some variables (e.g., a "1" signifying a respondent is "fearful"), neither ordered logit nor generalized ordered logit models performed well. For the latter reason, we also employ unweighted regression [54]. Regression models do, however, include controls for the differential probability of selection given stratification and for demographic (gender, education, and age) differences in response.

We present four regression models: (1) a cognitive-affective model that does not include interaction terms to account for the possibility of different cognitive and affective responses among those who moved-in (a) prior and (b) subsequent to commencement of construction [7,14], followed by separate (2) cognitive, (3) affective and (4) cognitive-affective (full) models, each of which includes interaction variables. In each of the four models we include only those respondents who answered each question in the cognitive-affective models (1415 in total; 1089, prior and 326 subsequent to commencement of construction). We report un-standardized coefficients, present partial omega's (ω^2) as measures of effect size, and employ robust standard errors to account for heteroscedasticity in each model. It is worth underscoring that given the limitations of the data, we are neither able to analyze those who lived in the wind project communities prior to the time of project construction, but moved away from those communities prior to survey implementation nor those who would have considered moving into those communities post-construction but for the presence of the local wind power project.

The attitude question in the survey, from which the main dependent variable was constructed, is worded: "What is your attitude toward the local wind project now?" Respondents could choose among "very negative", "negative", "neutral", "positive" "very positive" or "don't know". For analysis purposes we treated "don't know" responses (1.4% of the sample) as missing, creating a five level/category dependent variable.

Independent variables in the regression models fall into five groups: (1) cognitive; (2) affective; (3) demographic, which to control for non-response bias and because they may be correlated with the dependent variable (age, gender, education and home ownership); (4) project participation (hosting a wind turbine on one's property or otherwise receiving compensation); and (5) stratification variables (project size, under-/over-sampled project, distance of home to nearest wind turbine). When we included variables that account for the year the nearest turbine was installed and year an individual moved into their home, neither was significant and given that they had little effect on the other variables in the model, we do not include them here.

Cognitive variables include: process fairness; degree (not to very) of climate concern, whether a respondent "consider[s] wind energy to be an effective means to reduce climate change," and the fit of the wind turbines with the landscape, whether they were disruptive to the community or a landmark, and whether they are industrial or symbolize clean energy progress along with whether a respondent had a negative perception of the project's effect on property values. Affective variables are the attractiveness of the wind turbines, feelings toward the wind project (pride, fear, hope, helplessness, and anger), and annoyance by the planning and construction process and annoyance by the sound of the project. As noted earlier, cognitive and affect can become blurred at the margins, and some variables, e.g., "attractiveness" can arguably be considered cognitive in nature.

In the survey, LBNL asked respondents if they moved-in prior to construction and if so, were they aware of the project prior to construction. If they were aware, they were then asked separately whether they thought the public process was fair and whether they were annoyed by the planning and construction process (not at all to very or don't

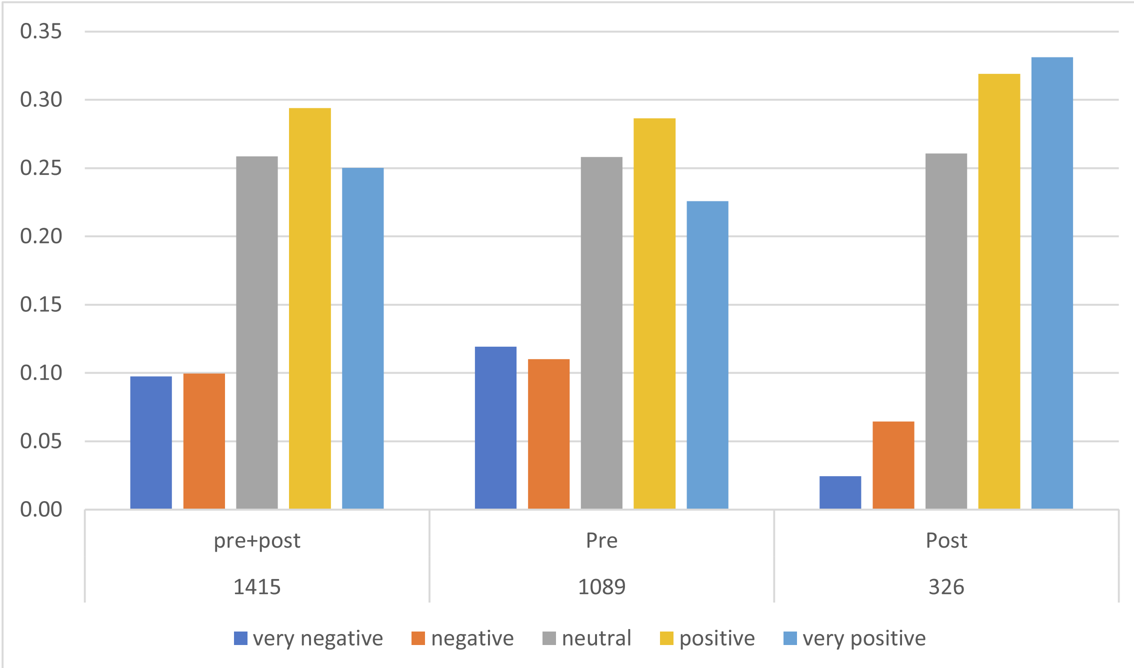

Fig. 2. Attitude of respondents (unweighted) toward the local wind power project from very negative to very positive. Variations differ on whether the sample data was whether the sample/subsample includes respondents irrespective of when they moved into their local community or whether they moved in prior (pre) or subsequent (post) to construction commencing.

know, for each). We tried different formulations of each variable, creating, e.g., factor variables that accounted for moving-in after construction, lack of awareness, degree of fairness and don't know; they all performed similarly in the regressions, for reasons of parsimony so we chose the simplest formulation for each—dummy variables for process fairness and annoyance (not at all and otherwise).

LBNL also asked whether a respondent liked the way the wind turbines looked. If a respondent checked yes, she was presented with the choices attractive, symbolizes progress toward clean energy, community landmark, fits well with the landscape of the local area, none of the above or don't know and asked to check all that apply. If she checked no, the choices were unattractive, industrial, disruptive to a community feel, does not fit the landscape of the local area, none or don't know and again asked to check all that apply. The respondent also had a third answer option for the question regarding liking the turbines' appearance: she could check "neutral, don't know or no opinion" (hereinafter "neutral"). We paired the answers to the follow-up questions along with the neutral answer to the first question, and created four 0–2 variables ranging, for example, from unattractive to neutral attractiveness to attractive. Following Hoen, et al. [7], we use the dummy variable, negative property perception, created from a pair of survey questions that asked homeowners whether they believed the project had affected their property value and if so, whether the effect was to increase or decrease the property value or whether they did not know.

We derived emotional dummy variables from a survey question that asked: "Which of the following best describes how you feel about the wind project." A respondent could then select one of the following: prideful, fearful, hopeful, helpless, angry, none of the above, or don't know. They are coded "1" if an emotion was checked, "0" if not checked and one of the other emotions, none of the above, or don't know was checked; We also include a variable that measures the degree (not at all to very) to which a respondent finds sound emanating from the local wind project to be annoying. Finally, we created an interaction variable between a dummy variable for having moved into one's home prior to construction and each cognitive and affective variable other than the dummy variables for process fairness and process annoyance, as by definition, only those respondents who moved-in prior to construction could potentially be assigned a "0."

In short, the models created here build on and depart from those in Hoen, et al. [7] in that we (a) consider affective variables in addition to cognitive ones; (b) develop an affect-only model; (c) include additional cognitive variables (community effect and clean energy progress/industrial; (d) focus on differences between those who moved-in prior and subsequent to construction, and include interaction terms; and (e) while Hoen, et al., [7,3] include cognitive variables in the model, we develop and interpret the models within the framework of the cognitive and affective literature.

4. Results

Fig. 2 presents proportion data for the variable attitude (very negative to very positive) toward the local project, which is the dependent variable in the regression models. Proportions are set out for the full regression model sample (N = 1415 due to question non-response for one or more of the variables in the model), pre- (n = 1089) and post-construction (n = 326) subsamples. In each model, at least 50% have a positive or very positive attitude, with<25% having a negative or very negative attitude. Weighted samples show smaller percentages who have negative or very negative attitudes than unweighted samples (e.g., 9% versus 20% in the full model). See Hoen, et al [7] for further discussion of attitude. As noted earlier, the regression models, although unweighted control for unequal probability of selection and differential rates of response. Lastly, a comparison of those who moved-into their homes pre-construction to those who moved-in after reveals that a

Table 1
Spearman's rank correlation matrix for cognitive and affective variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) age	1.00																	
(2) female	−0.02	1.00																
(3) college	−0.11*	−0.04	1.00															
(4) process fairness	−0.04	0.04	0.04	1.00														
(5) climate concern	0.04	0.13*	0.14*	0.03	1.00													
(6) wind climate mitigation	−0.01	0.01	0.08*	0.14*	0.44*	1.00												
(7) landscape fit	0.05	0.03	0.01	0.32*	0.11*	0.26*	1.00											
(8) community effect	0.03	−0.01	0.04	0.30*	0.11*	0.26*	**0.68***	1.00										
(9) industrial/progress	0.04	−0.01	0.03	0.30*	0.17*	0.33*	**0.67***	**0.66***	1.00									
(10) negative property perception	−0.05*	−0.01	0.01	−0.41*	−0.04	−0.21*	−0.43*	−0.42*	−0.44*	1.00								
(11) process annoyance	−0.17*	0.03	−0.01	−0.08*	−0.02	−0.14*	−0.27*	−0.28	−0.29*	0.20*	1.00							
(12) attractive	0.04	0.03	0.03	0.30*	0.13*	0.28*	**0.74***	**0.68***	**0.65***	−0.40*	−0.29*	1.00						
(13) prideful	0.05	−0.02	0.04	0.14*	0.10*	0.22*	0.32*	0.36*	0.34*	−0.21*	−0.21*	0.36*	1.00					
(14) hopeful	0.01	0.04	0.02	0.16*	0.08*	0.14*	0.24*	0.18*	0.26*	−0.23*	−0.10*	0.18*	−0.42*	1.00				
(15) fearful	0.01	−0.01	−0.04	0.01	−0.05*	−0.11*	−0.08*	−0.11*	−0.08*	0.06*	0.05	−0.12*	−0.05*	−0.08*	1.00			
(16) helpless	0.04	−0.04	−0.03	−0.16*	−0.08*	−0.18*	−0.36*	−0.28*	−0.35*	0.29*	−0.17*	−0.32*	−0.19*	−0.29*	−0.04	1.00		
(17) angry	−0.01	−0.02	−0.04	−0.44*	−0.06*	−0.20*	−0.36*	−0.37	−0.33*	0.46*	−0.15*	−0.34	−0.15*	−0.24*	−0.03	−0.11*	1.00	
(18) sound annoyance	−0.08*	−0.05	−0.07*	−0.36*	−0.09*	−0.20*	−0.46*	−0.40	−0.45*	0.55*	−0.20*	−0.41*	−0.22*	−0.24*	0.02	0.37*	0.39*	1.00

* significant at 0.05 level, with moderate to strong correlations **bolded**.

greater percentage of the former (23%, unweighted) hold negative or very negative attitudes toward their local project than the latter (8%, unweighted).

In Table 1, we present a correlation matrix among the cognitive and affective variables of interest. Variable definitions are found in Table 2. There are numerous significant correlations, with six that are moderate to strong: They are between industrial/clean energy progress and attractive (0.65), community effect (0.66) landscape fit (0.67); between community effect and landscape fit (0.68); and between attractive and community effect (0.68) and landscape fit (0.74). Importantly, however, the regression models without interactive terms (not shown) do not show evidence of multicollinearity.[1] Although we have not included correlations between the cognitive and affective variables and hosting a wind turbine on one's property or otherwise receiving compensation from the developer, the correlations are all non-significant, or if significant, weak, with coefficients |<0.15|.

In Table 2, we also provide means, proportions, and standard errors for the variables (other than the interactive variables) included in the regression models. We do so for the pre- and post-construction samples, and the combined sample, in each case limiting the analysis to only those 1415 observations that are included in the regression analysis. Table 2 also includes mean and proportion comparisons tests—t tests for means and chi-square tests for proportions—between those who moved-in prior and subsequent to construction commencement. Those who moved-in prior to construction have less positive (but still positive on average) attitudes than those who moved in subsequent (3.39–3.87).

There are also statistically significant differences among several cognitive variables with less "positive" (although still positive) opinions regarding the local project's fit with the landscape, effect on the community, symbolic representation of clean energy progress being held by those individuals who moved-in prior to construction commencement and more negative perceptions of the local project's effect on property values. Turning to affective variables, we see that those who moved-in after construction tend to be more hopeful, and feel less helpless, angry, and annoyed by the sounds emanating from the wind turbines.

Lastly, there are also demographic differences between the two populations, with those who moved-in subsequent to construction being younger (51 to 61), more likely to have at least a bachelor's degree (0.44–0.34), less likely to own their home (0.83–0.97), more likely to live near a smaller wind project and more likely to live at a further distance from the nearest wind turbine. They are also less likely to have a wind turbine on their property (0.04–0.07) and more likely to receive no compensation from the developer (0.87–0.81). These findings provide support for the hypothesis that those who moved-in subsequent to commencement of construction differ significantly from those who moved in prior to.

In Table 3, we present the full cognitive-affective model without regard to whether a respondent moved into an area with a wind power project prior or subsequent to commencement of construction. The data fit the model well **(R^2 = 0.702).** Five of the seven cognitive variables—wind power as an effective means to mitigate climate change, process fairness, the project symbolizing clean energy progress as compared to being industrial, having a negative property perception, and the fit with the landscape—are significant, although their effect sizes (ω^2) are small (0.02 for the wind power as climate change mitigation; 0.00 for landscape fit, and 0.01 for the other three variables). Six of the eight affect variables are significant, with medium effect sizes (ω^2) associated with pride (0.10), anger (0.07), and helplessness (0.05). These are followed by hopeful and annoyance from the sound of the wind turbines (0.02 each) and attractive (0.01).

[1] Interaction terms by their nature are collinear with the underlying variables; moreover, each of the cognitive and affect variable interaction are interacted with the same variable that differentiates pre- from post-construction.

Table 2
Regression variable (not including interactive terms) definitions along with Means/Proportions (including standard error) of observations included in regression models.

Variable	Variable Description/Definition/Coding	Combined N = 1,415 Mean/ Proportion (SE)	Pre-construction n = 1,089 Mean/Proportion (SE)	Post-construction n = 326 Mean/Proportion (SE)	Pre/Post Mean (*t* test)/ Proportion (chi^2 test) P value
Dependent					
Project attitude	very negative to very positive (1–5); don't know excluded	3.50 (0.03)	3.39 (0.04)	3.87 (0.06)	<0.001**
Cognitive					
Process fairness	"0″ if not at all fair, "1" otherwise	0.91 (0.01)	0.88 (0.01)	NA	NA
Climate concern	not to very concerned (0–4)	2.21 (0.04)	2.21 (0.04)	2.19 (0.08)	0.799
Wind-climate mitigation	no to don't know to yes (0–2)	1.28 (0.02)	1.28 (0.03)	1.31 (0.05)	0.550
Landscape fit	fits bad to fits good (0–2)	1.13 (0.02)	1.10 (0.02)	1.23 (0.03)	0.005**
Community affect	disruptive to landmark(0–2)	1.20 (0.02)	1.18 (0.02)	1.27 (0.03)	0.033*
Industrial/progress	industrial to symbol of clean energy progress (0–2)	1.41 (0.02)	1.38 (0.02)	1.49 (0.03)	0.013*
Property perception	"1″ if negative; "0" if otherwise	0.18 (0.01)	0.21 (0.01)	0.08 (0.02)	<0.001**
Affective					
Process annoyance	"0″ if not at all annoyed, "1" otherwise	0.74 (0.01)	0.67 (0.01)	NA	NA
Attractive	unattractive to attractive (0–2)	1.06 (0.02)	1.04 (0.02)	1.11 (0.03)	0.083
Prideful	"1″ if prideful'; "0" if not	0.22 (0.01)	0.21 (0.01)	0.24 (0.02)	0.206
Hopeful	"1″ if hopeful; "0" if not	0.40 (0.01)	0.37 (0.01)	0.46 (0.03)	0.004**
Fearful	"1″ if fearful; "0" if not	(0.003)			
	0.01 (0.003)	0.02 (0.01)	0.433		
Helpless	"1″ if helpless; "0" if not	0.12 (0.01)			
	0.14 (0.01)	0.06 (0.01)	<0.001**		
Angry	"1″ if angry; "0" if not	0.08 (0.01)	0.10 (0.01)	0.02 (0.01)	<0.001**
Sound annoyance	not at all to very (0–4)	0.70 (0.04)	0.83 (0.04)	0.32 (0.05)	<0.001**
Demographic					
Age	age in years	58 (0.39)	61 (0.40)	51 (0.95)	<0.001**
Female	"1″ if female; "0" male	0.53 (0.01)	0.53 (0.02)	0.51 (0.03)	0.578
College	"1″ if at least bachelor's degree; "0" if less	0.36 (0.01)	0.34 (0.01)	0.44 (0.03)	<0.001**
Home ownership	"1″ if own home; "0" if rent	0.93 (0.01)	0.97 (0.01)	0.83 (0.02)	<0.001**
Project participation					
No participation	"1″ if no compensation; "0" otherwise	[a]0.82 (0.01)	[a]0.81 (0.01)	[a]0.87 (0.02)	[a]0.021*
Compensated, no turbine	"1″ if compensated, but no turbine; "0" otherwise	[a]0.12 (0.01)	[a]0.12 (0.01)	[a]0.10 (0.02)	[a]0.255
Wind turbine on property	"1″ if on respondent's property; "0" otherwise	[a]0.06 (0.01)	[a]0.07 (0.01)	[a]0.04 (0.01)	[a]0.033*
Stratification variables					
Large project	"1″ if greater than 10 turbines; "0" otherwise	0.64 (0.01)	0.67 (0.01)	0.53 (0.03)	<0.001**
Under-sampled project	"1″ if under-sampled given large nearby population; "0" otherwise	0.07 (0.01)	0.06 (0.01)	0.09 (0.02)	0.063
Oversampled project	1″ if oversampled case study; "0″ if otherwise	0.33 (0.01)	0.34 (0.01)	0.29 (0.02)	0.100
Less than or equal to 0.8 km to nearest turbine	"1″ if live in specified distance range; "0" otherwise (omitted category)	[a]0.35(0.01)	[a]0.38 (0.01)	[a]0.26 (0.02)	[a] < 0.001**
0.8–1.6 km to nearest turbine	"1″ if in specified distance range; "0" otherwise	[a]0.30 (0.01)	[a]0.30 (0.01)	[a]0.29 (0.03)	[a]0.648
1.6–4.8 km to nearest turbine	"1″ if in specified distance range; "0" otherwise	[a]0.19(0.01)	[a]0.17 (0.01)	[a]0.23 (0.02)	[a]0.030*
4.8–8 km to nearest turbine	"1″ if in specified distance range; "0" otherwise	[a]0.16 (0.01)	[a]0.14 (0.01)	[a]0.22 (0.02)	[a]0.001**

*Significant at 0.05 level; ** significant at 0.01 level.
[a] Proportion rather than mean.

Table 3
Cognitive-Affective Regression Model not accounting for pre- and post-construction move-in.

N = 1415	Unweighted (R^2 = 0.70)			
Variable	Coefficient	Robust SE	P value	ω^2
Stratification/demographics/compensation				
0.8–1.6 km to nearest turbine	−0.07	0.05	0.147	0.01
1.6–4.8 km to nearest turbine	−0.14	0.06	0.014*	
4.8–8.0 km to nearest turbine	−0.20	0.06	0.002**	
Large/small project	0.01	0.04	0.766	0.00
Under-sampled project	0.00	0.07	0.976	0.00
Over-sampled project	−0.05	0.04	0.214	0.00
Age	0.00	0.00	0.060	0.00
Female	−0.01	0.04	0.854	0.00
College	0.12	0.04	0.002**	0.01
Own	−0.03	0.08	0.736	0.00
compensation	0.07	0.06	0.225	0.00
Host	0.17	0.08	0.040*	
Cognitive				
Process fairness	0.22	0.08	0.005**	0.01
Climate concern	0.00	0.01	0.779	0.00
Wind climate mitigation	0.13	0.03	0.000**	0.02
Landscape fit	0.09	0.05	0.045*	0.00
Community effect	0.04	0.05	0.427	0.00
Progress/industrial	0.17	0.04	0.000**	0.01
Negative property perception	−0.31	0.07	0.000**	0.01
Affective				
Process annoyance	−0.09	0.05	0.056	0.00
Attractive	0.16	0.05	0.002**	0.01
Prideful	0.80	0.06	0.000**	0.10
Hopeful	0.29	0.06	0.000**	0.02
Fearful	−0.08	0.26	0.763	0.00
Helpless	−0.69	0.08	0.000**	0.05
Angry	−1.01	0.10	0.000**	0.07
Sound annoying	−0.11	0.02	0.000**	0.02
Constant	2.98	0.13	0.000**	

*Significant at the 0.05 level; **significant at the 0.01 level.

In Table 4, we present coefficients and p values of the cognitive and affective variables in each of the three models (cognitive, affective and full), comparing the values for each variable between those who moved-in prior and subsequent to construction. Each prior to construction value was derived by forming a linear combination between the variable (e.g., attractive) and the related pre-construction interactive term (e.g., pre#attractive). Full models are found in the appendix (Table A1), including measures of effect size (partial ω^2). Although no interaction term on its own is significant, the linear combinations for a number of the cognitive and affective variables are instructive as we describe next.

In the cognitive model, all of the cognitive variables with the exception of climate concern are statistically significant. The coefficients on the variables are generally similar, with the largest differences being that among those are who moved-in prior to construction, the fit with the landscape (0.37–0.28) and considering the local project to represent clean energy progress as opposed to being industrial (0.32–0.40) has a greater than and lesser than, respectively, effect on attitude, as compared to those who moved-in subsequently. In the affective model, all except the emotion of fear are statistically significant. Among the emotions, the largest coefficients (absolute value) are associated with anger (−1.30 and −1.29) and pride (0.89 and 1.01). Some of the larger differences in coefficients between pre- and post-construction are associated with the variable helpless (−0.86 to −0.66) and hopeful (0.34 and 0.48). Although the data fits both models well, it is worth noting that the affective model has a larger R^2 (0.679) than the cognitive model (0.593)

In the combined model, the coefficients on each of the significant cognitive and affective variables is smaller than in the separate models. Moreover, for those who moved-in prior to construction, the cognitive variables fit with the landscape and the effect on the community are no longer significant, while all the affective variables remain so. Considering those who moved-in subsequent to construction, the cognitive variable community effect and the affective variables hopeful and sound annoyance are no longer significant. Among the emotions, anger (−0.99 and −1.23) and pride (0.79 and 0.71) continue to have the largest coefficients (absolute value). Interestingly, the coefficient on anger decreased from −1.30 to −0.99) for those who moved-in pre-construction, but not so much for those who moved in subsequent (−1.29 to −1.23) while the effect on pride was more pronounced for the latter.

5. Discussion

With this analysis, we have attempted to discern from a representative cross-section of U.S. wind project neighbors, the cognitive and affective nature of attitudes towards local wind power projects. Our results add important context and a novel approach to prior work [7,51,53,55], including the differences between pre- and post-construction neighbors' evaluations of projects. We find that cognition (fit with the landscape, perceiving wind power to be an effective means

Table 4
Variable coefficients and P values for cognitive and affective variables in three regression models, comparing those who moved in pre- to those who moved-in post-construction.

n = 1415	Cognitive (R^2 = 0.59)				Affective (R^2 = 0.68)				Full (R^2 = 0.71)			
Construction	Pre		Post		Pre		Post		Pre		Post	
<u>Cognitive</u>	Coeff.	P Value	Coeff.	P Value	Coeff.	P Value	Coeff.	P Value	Coeff.	P Value	Coeff.	P Value
Process fairness	−0.51	0.000**							−0.22	0.007**		
Climate concern	−0.01	0.949	0.03	0.411					−0.04	0.644	0.02	0.470
Wind climate mitigation	0.23	0.000**	0.26	0.000**					0.12	0.000**	0.19	0.002**
Landscape fit	0.37	0.000**	0.28	0.003**					0.07	0.193	0.18	0.046*
Community effect	0.24	0.000**	0.27	0.013**					0.03	0.511	0.08	0.465
Progress/industrial	0.32	0.000**	0.40	0.000**					0.16	0.001**	0.19	0.029*
Negative property perception	−0.74	0.000**	−0.70	0.000**					−0.26	0.000**	−0.52	0.001**
Affective												
Process annoyance					0.18	0.000**			0.15	0.003**		
Attractive					0.34	0.000**	0.39	0.000**	0.19	0.002**	0.07	0.511
Prideful					0.89	0.000**	1.01	0.000**	0.79	0.000**	0.71	0.000**
Hopeful					0.34	0.000**	0.48	0.000**	0.29	0.000**	0.21	0.064
Fearful					−0.27	0.409	−0.16	0.710	−0.13	0.693	0.11	0.740
Helpless					−0.86	0.000**	−0.66	0.002**	−0.69	0.000**	−0.61	0.008**
Angry					−1.30	0.000**	−1.29	0.000**	−0.99	0.000**	−1.23	0.000**
Sound annoyance					−0.17	0.000**	−0.16	0.019**	−0.11	0.000**	−0.06	0.343

*Significant at the 0.05 level; **significant at the 0.01 level.

of climate mitigation and property value perceptions) is more important in attitude formation for those who moved into a community subsequent to project construction than it is for those who moved-in prior to construction. Affect is more mixed, although attractiveness is significant for those who moved-in prior to construction but not for those who moved-in subsequently. Considering only the visual relationship with attitude, attitudes of those who moved-in pre-construction are shaped more by affect (wind turbine attractiveness) while the attitudes of those who moved into wind turbine communities subsequently are shaped more by cognitive responses (fit of the wind turbines with the landscape). In this, we rely on the interpretation of attraction (being drawn to or repelled from) as affective [44], while acknowledging that some variables can be either cognitive or affective dependent upon context and survey construction.

This analysis also builds on Hoen et al. [7], by focusing on the role of emotions in attitude formation analyzed independent of and in concert with other variables. We have shown that a dual-process model of affect and cognition reveals distinct pathways of perception used by wind project neighbors and that, as between the two, affect is the dominant factor in assessing attitude.

Attitude towards neighboring wind projects across all models is generally positive with at least 50% showing either positive or very positive and <25% showing negative or very negative. This seems consistent with lessons from the literature that U.S. wind energy support is high [11], but we reiterate here the importance of distinguishing attitude from support as well as delving into the “individual gap” [6]. For U.S. wind neighbors, the proportion of those holding negative attitudes is higher among those who lived in an area prior to the installation of the turbines. In addition to the more general effects on attitude of Tiebout sorting, which is grounded in utility-maximization, we have captured part of the psychological factors that go into the evaluation of utility. In relation to our second research question, our models shine some light on pre- and post-construction move-in differences.

Indeed, there are particular and important differences between those who move into areas before or after wind project construction. Looking at the simple descriptive statistics, we see statistically significant differences in the demographic and stratification variables. Those who moved into the community prior to project construction were less positive about the turbines’ fit with the landscape and less likely to view the project as a community landmark and as representing clean energy progress. The proportion who hold the perception that there is a negative effect on property value is more than two and a half times greater among pre-construction neighbors than post-construction. Post-construction neighbors are younger, more likely to carry at least a bachelor’s degree, slightly more likely to rent their home, and less likely to live within a kilometer of any project. Although, these last variables have small effect-sizes in the regression models, it may suggest that there are still tipping-points in the decision to move near a project regardless of positive attitudes towards the technology or that people who live near projects do not want to move away from them or have difficulty selling their homes.

The regression analyses present an overall model irrespective of pre- or post-construction that includes demographic and stratification variables; pre- and post-construction cognitive and affective models; and a dual-process model for both populations. Many of the variables have statistically significant regression coefficients, so we also report effect-size in the overall model to bolster our interpretation of their relative importance. This goes directly to our first research question. It is notable, that across the regression models, emotions (both positive and negative affect) show the largest effect-sizes by a large margin. This is especially true with the emotions of pride, helplessness, anger, and to a lesser extent hope and sound-annoyance. The exception is fear. In contrast, the cognitive variable with the largest effect-size across the entire population is the perception of wind energy’s capability to mitigate climate change with both pre- and post-construction neighbors answering in similar fashion. The effect-sizes of the included demographic and stratification variables are de minimis.

We hypothesized that pre- and post-construction neighbors would differ in the relationships between their attitude and the cognitive and affective variables. More specifically, we hypothesized that negative emotions would distinguish pre-construction neighbors in particular. Process fairness and process annoyance could not be compared across populations; however, fairness shows the larger absolute value regression coefficient. Interestingly, other cognitive variables in the dual-process model including property value effects and landscape fit are more pronounced for those who moved into the community subsequent to construction whereas both variables had larger coefficients for pre-construction neighbors in the cognitive-only model. Project attractiveness and sound annoyance as well as the emotions of pride, hope, and helplessness are more pronounced in pre-construction populations in the full model. Anger, though, has a larger coefficient for the post-construction population. In the affect-only model, anger is similar for pre- and post-construction populations and post-construction populations show larger coefficients for positive affect.

Emotions research indicates that it is important to go beyond mere valence (mere positive or negative affect) and that there is an important distinction in the evaluation of risk between discrete emotions [28,56,45,46]. Fear, which was not significant in our models, is described by Böhm [28 p.206] as a “prospective consequence-based emotion,” meaning that it is forward-looking and concerned with end-results. In contrast, anger which is significant in our models, is described as “other-related and ethics-based” [28 p.206], meaning that it is deontological or process-based and focused on the actions of others. Anger has also been strongly tied to both procedural and distributive unfairness and pride to prior awareness, trust, and perceived benefits [46]. Our data do not have questions regarding the potential for additional projects in the vicinity, which potentially explains the lack of fear, but the shrinking of the coefficient for anger from our affect model to the dual-process model where fairness and the property value perceptions are included may be telling. Future research should work to draw out the relationship between these variables and different emotional responses. If, for instance, fears around turbine siting, construction, or benefits distribution are not addressed and anger develops in neighboring communities, what potential avenues of discourse become unavailable (e.g. education and outreach) and how should project developers and officials respond? Knowing more about when and where to spend resources to increase public engagement based on cognitive/affective responses could mean the difference between project cancellation and success or whether the project will be remembered for being controversial or for engendering positive attitudes.

Comparing the individual and dual-process models, effect on the community is only significant in the cognitive-only model for both populations; however, landscape fit remains significant for post-construction neighbors in the full model. Similarly, sound annoyance drops off for post-construction neighbors in the dual-process model. Overall, these results suggest that we cannot support our second hypothesis that the pre-construction neighbors are distinct from post-construction neighbors predominantly by their negative emotions, especially when a dual-process model is used. Instead, it appears that the relative importance of affect overall is more telling with the relative coefficients of all affective variables being larger except for anger, which is of similar importance for pre- and post-construction neighbors. In the affective-only model it is the relative coefficients of positive emotions (i.e. pride and hope) as well as the negative emotion of helplessness between the two populations that is telling. One of the primary findings of Truelove [39] regarding energy siting was that cognitive models predicted more variance than affective models. Our situation is inverted to this, with affective variables describing the lion's share of the variance in the full models.

Interpreting the direct policy implications of this work necessitates one to first refer back to the work of Cass and Walker [37] where the role of emotion in the wind energy planning process is explored through interviews with project developers. It is still very possible that the elicitation of an emotional response in the siting of a wind energy (or other infrastructure) project is seen as a failure of rational planning that results in protest. Such a "self-fulfilling prophecy" [37 p.68], as they put it, fails to take into account many of the lessons that can be learned from striving to understand emotional responses. These include the positive emotions like pride and hopefulness, along with the relationship between negative emotional responses and aspects of place attachment, dependence, and identity. Those who are empowered to run the siting process of wind projects might do best to reconceptualize a pure rational actor approach to interactions with communities into one grounded in a just and fair siting process that also gives dignity and respect to people and their emotions.

6. Limitations and future work

This work was part of a larger national study of wind turbines neighbors which put primary emphasis on other aspects of wind power's relationship (e.g., responses to sound annoyance) to communities and their members, and as a result, the development of cognitive and emotional markers in the survey was somewhat limited. Had the original survey been more geared toward this end, more emotional dimensions would have been included as well as methods for examining them more deeply. For instance, the intensity of emotions have been shown to matter [46] and could provide further insight into differences between somewhat milder and more intense attitudes [40]. It also does not capture the attitudes of individuals who lived in the vicinity of failed project proposals, where perceptions of local community members may be influenced differently by cognitive and affective forces. Employing mixed methods and supplementing this work with qualitative studies such as semi-structured interviews or focus groups would also be valuable.

7. Conclusions

Ideally, new wind projects are an exercise in compromise between developers, local regulators, and communities that will host the wind turbines. The increasing numbers of new projects means that many will be situated near people in one way or another. Either projects will come to where people live, or people will inevitably find themselves near projects – a distinction which may prove important given our findings

Through analyzing the data using this dual-process model, our results support findings in Firestone et al. [53] and Hoen et al. [7] regarding the differences between pre- and post-construction move-in populations. This work corroborates the theory first developed by Tiebout [14] and suggests that to move near wind projects after they've been built correlates with more positive attitudes, but also less intense emotional responses. Emotions and attitudes vary between pre- and post-construction wind project neighbors, although not based predominantly on negative affect as we hypothesized. That there are both positive and negative affective predictors of attitude is enlightening, as understanding them and even utilizing them may lend a hand in efforts to effectively open communications between different stakeholders. In other words, as described by Rinscheid and Wustenhagen [57], it is the pairing of rational and technical information with an "emotional hook." Additionally, going the extra step to anticipate the drivers of particular emotional responses based on a project's status (i.e., planning, construction, operation, etc.) as well as utilizing education and outreach to reduce fear and perhaps produce hope and prime pride may be intelligent uses of developer and policy-maker resources.

In simple terms, the affect side of the dual-process model is the fast response, but it may also be the lingering response for those who have perceived the process and/or outcome as unfair. It is not to say that perceptions driven strongly by emotions, as we have shown here, are 'baked in'. In fact, we would expect that, given time, emotions may change [19]. It may be that affective response to a given stimulus diminishes in explanatory power over time and pre-construction neighbors become more like post-construction neighbors. A good question for future research is, then, how long might it take? The authors also wonder if, in such a case, does all perception decrease and the project become in some ways another invisible component of the energy system [58]? Lessons may be learned in this regard by using dual-process models to analyze long-established project perceptions over time. Ideally, case studies of new projects could trace aspects of change in cognition and affect from conception over project lifetimes. Moreover, there are many wind projects that have reached or are approaching decommissioning age where decisions to remove or retool them must be made. Affect may thus rise again with new controversy or simply old controversy made raw again.

Funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Since 2010, Jeremy Firestone has held various roles in First State Marine Wind, LLC, (FSMW), a private corporation that is majority controlled by the University of Delaware (UD). FSMW owns and operates a 2 MW wind turbine adjacent to the UD's Lewes campus and sells energy to UD and to the city of Lewes, Delaware. Aaron Russell claims no conflicts.

Acknowledgements

The authors thank the Lawrence Berkeley Lab for providing access to the data to undertake the analysis and the Magers Family Fellowship for providing graduate funding to the lead author.. We acknowledge Ben Hoen, Joe Rand, Jeremy Firestone, Gundala Hübner, Johannes Pohl and Debi Elliot for their work on writing the survey instrument, collecting the survey data, and preparing the data for analysis.

Appendix A

Table A1
Attitudinal linear regression models-cognitive, affective and full.

N = 1415	Cognitive Unweighted (R2 = 0.59)				Affective Unweighted (R2 = 0.68)				Cognitive-Affective (Full) Unweighted (R2 = 0.71)			
Variable	Coeff.	SE	P value	ω^2	Coeff.	SE	P value	ω^2	Coeff.	SE	P value	ω^2
Stratification/demographics/compensation												
0.8–1.6 km to nearest turbine	0.06	0.06	0.258	0.003	−0.07	0.051	0.152	0.006	−0.07	0.05	0.169	0.007
1.6–4.8 km to nearest turbine	−0.06	0.07	0.360		−0.13	0.060	0.031*		−0.15	0.06	0.009**	
4.8–8.0 km to nearest turbine	−0.11	0.07	0.130		−0.21	0.067	0.002**		−0.21	0.07	0.001**	
Large/small project	−0.01	0.05	0.801	−0.001	−0.01	0.04	0.837	−0.001	0.03	0.04	0.549	0.000
Under-sampled project	0.05	0.08	0.497	0.000	0.02	0.08	0.805	−0.001	0.01	0.07	0.874	−0.001
Over-sampled project	−0.04	0.05	0.398	0.000	−0.04	0.04	0.314	0.000	−0.05	0.04	0.229	0.000
Age	0.0001	0.00	0.935	−0.001	0.00	0.00	0.148	0.001	−0.001	0.001	0.301	0.000
Female	0.04	0.04	0.403	0.000	−0.01	0.04	0.754	−0.001	−0.001	0.04	0.978	−0.001
College	0.18	0.04	0.000**	0.010	0.10	0.04	0.015*	0.003	0.11	0.04	0.006**	0.004
Own	−0.01	0.09	0.938	−0.001	−0.01	0.08	0.917	−0.001	0.01	0.08	0.929	−0.001
Compensation	0.20	0.07	0.005**	0.007	0.06	0.06	0.291	0.004	0.06	0.06	0.270	0.002
Host	0.26	0.10	0.012*		0.23	0.08	0.004**		0.18	0.08	0.027*	
Cognitive												
Process fairness	0.51	0.09	0.000**	0.03					0.22	0.08	0.007**	0.005
Climate concern	0.03	0.04	0.411	0.000					0.02	0.03	0.470	0.000
Wind climate mitigation	0.26	0.06	0.000**	0.011					0.19	0.06	0.002**	0.007
Landscape fit	0.28	0.09	0.003**	0.006					0.18	0.09	0.046*	0.002
Community effect	0.27	0.11	0.013*	0.004					0.08	0.11	0.465	0.000
Progress/industrial	0.40	0.09	0.000**	0.013					0.19	0.09	0.029*	0.003
Negative property perception	−0.70	0.15	0.000**	0.012					−0.52	0.16	0.001**	0.007
Affective												
Process annoyance					−0.18	0.05	0.000**	0.009	−0.15	0.05	0.003**	0.006
Attractive					0.39	0.07	0.000**	0.025	0.07	0.10	0.511	0.000
Prideful					1.01	0.12	0.000**	0.050	0.71	0.13	0.000**	0.022
Hopeful					0.48	0.10	0.000**	0.018	0.21	0.12	0.064	0.002
Fearful					−0.16	0.44	0.710	−0.001	0.11	0.33	0.740	−0.001
Helpless					−0.66	0.22	0.002**	0.006	−0.61	0.23	0.008*	0.006
Angry					−1.29	0.25	0.000**	0.012	−1.23	0.18	0.000*	0.012
Sound annoying					−0.16	0.07	0.019*	0.006	−0.06	0.06	0.343	0.000
Interaction												
Pre#climate concern	−0.04	0.04	0.319	0.000					−0.02	0.03	0.498	0.000
Pre#wind climate mitigation	−0.04	0.07	0.618	−0.001					−0.06	0.07	0.350	0.000
Pre#landscape fit	0.09	0.11	0.420	0.000					−0.11	0.10	0.298	0.000
Pre#community effect	−0.03	0.12	0.790	−0.001					−0.05	0.12	0.692	−0.001
Pre#progress/industrial	−0.08	0.10	0.430	0.000					−0.03	0.10	0.759	−0.001
Pre#negative property perception	−0.04	0.16	0.822	−0.001					0.26	0.18	0.139	0.001
Pre#attractive					−0.05	0.07	0.509	0.000	0.12	0.12	0.317	0.000
Pre#prideful					−0.13	0.14	0.353	0.000	0.08	0.15	0.576	0.000
Pre#hopeful					−0.14	0.11	0.205	0.001	0.08	0.13	0.535	0.000
Pre#fearful					−0.11	0.55	0.841	−0.001	−0.24	0.47	0.605	0.000
Pre#helpless					−0.20	0.23	0.366	0.000	−0.08	0.24	0.749	−0.001
Pre#angry					−0.01	0.26	0.955	−0.001	0.24	0.21	0.242	0.000
Pre#sound annoying					−0.01	0.07	0.889	−0.001	−0.05	0.07	0.436	0.000
Constant	2.12	0.15	0.000**		3.25	0.13	0.000**		2.85	0.14	0.000**	

*Significant at the 0.05 level; **significant at the 0.01 level.

References

[1] US EIA, Wind became the third-largest source of U.S generation capacity in 2019, surpassing nuclear capacity, Electricity Monthly Update - Energy Information Administration. (2020). https://www.eia.gov/electricity/monthly/update/archive/april2020/ (accessed May 26, 2020).
[2] W. Kempton, J. Firestone, J. Lilley, T. Rouleau, P. Whitaker, The offshore wind power debate: views from cape cod, Coastal Management 33 (2) (2005) 119–149, https://doi.org/10.1080/08920750590917530.
[3] M.J. Pasqualetti, E. Butler, Public reaction to wind development in California, Int. J. Ambient Energy 8 (2) (1987) 83–90, https://doi.org/10.1080/01430750.1987.9675521.
[4] M.J. Pasqualetti, Opposing wind energy landscapes: a search for common cause, Ann. Assoc. Am. Geogr. 101 (4) (2011) 907–917, https://doi.org/10.1080/00045608.2011.568879.
[5] A. Russell, J. Firestone, D. Bidwell, M. Gardner, Place meaning and consistency with offshore wind: An island and coastal tale, Renew. Sustain. Energy Rev. 132 (2020) 110044, https://doi.org/10.1016/j.rser.2020.110044.
[6] D. Bell, T. Gray, C. Haggett, The 'social gap'in wind farm siting decisions: explanations and policy responses, Environ. Politics 14 (2005) 460–477.
[7] B. Hoen, J. Firestone, J. Rand, D. Elliot, G. Hübner, J. Pohl, R. Wiser, E. Lantz, T. R. Haac, K. Kaliski, Attitudes of U.S. wind turbine neighbors: analysis of a nationwide survey, Energy Policy 134 (2019) 110981, https://doi.org/10.1016/j.enpol.2019.110981.
[8] T.R. Peterson, J.C. Stephens, E.J. Wilson, Public perception of and engagement with emerging low-carbon energy technologies: a literature review, MRS Energy Sustain. 2 (2015), https://doi.org/10.1557/mre.2015.12.
[9] D. Bidwell, Thinking through participation in renewable energy decisions, Nat Energy 1 (5) (2016), https://doi.org/10.1038/nenergy.2016.51.
[10] M.B. Lane, Public participation in planning: an intellectual history, Aust. Geogr. 36 (3) (2005) 283–299, https://doi.org/10.1080/00049180500325694.
[11] J. Rand, B. Hoen, Thirty years of North American wind energy acceptance research: what have we learned? Energy Res. Social Sci. 29 (2017) 135–148, https://doi.org/10.1016/j.erss.2017.05.019.
[12] P. Devine-Wright, Think global, act local? The relevance of place attachments and place identities in a climate changed world, Global Environ. Change 23 (1) (2013) 61–69, https://doi.org/10.1016/j.gloenvcha.2012.08.003.
[13] P. Devine-Wright, Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action, J. Community. Appl. Soc. Psychol. 19 (6) (2009) 426–441, https://doi.org/10.1002/casp.1004.
[14] C.M. Tiebout, A pure theory of local expenditures, J. Polit. Econ. 64 (5) (1956) 416–424, https://doi.org/10.1086/257839.
[15] N.M.A. Huijts, G. de Vries, E.J.E. Molin, A positive shift in the public acceptability of a Low-carbon energy project after implementation: the case of a hydrogen fuel station, Sustainability 11 (2019) 2220, https://doi.org/10.3390/su11082220.
[16] D. Kahneman, J.L. Knetsch, R.H. Thaler, Anomalies: the endowment effect, loss aversion, and status quo bias, J. Econ. Perspect. 5 (1991) 193–206.
[17] A. Tversky, D. Kahneman, Loss aversion in riskless choice: a reference-dependent model, Q. J. Econ. 106 (1991) 1039–1061.

[18] E. Harmon-Jones, C. Harmon-Jones, Cognitive dissonance theory after 50 years of development, Z. Sozialpsychol. 38 (1) (2007) 7–16, https://doi.org/10.1024/0044-3514.38.1.7.
[19] D.A. Kermer, E. Driver-Linn, T.D. Wilson, D.T. Gilbert, Loss aversion is an affective forecasting error, Psychol. Sci. 17 (8) (2006) 649–653, https://doi.org/10.1111/j.1467-9280.2006.01760.x.
[20] P. Slovic, J.H. Flynn, M. Layman, Perceived risk, trust, and the politics of nuclear waste, Science 254 (5038) (1991) 1603–1607, https://doi.org/10.1126/science:254.5038.1603.
[21] N. Gupta, A.R.H. Fischer, L.J. Frewer, Socio-psychological determinants of public acceptance of technologies: a review, Public Underst Sci. 21 (7) (2012) 782–795, https://doi.org/10.1177/0963662510392485.
[22] M. Wolsink, Social acceptance revisited: gaps, questionable trends, and an auspicious perspective, Energy Res. Social Sci. 46 (2018) 287–295, https://doi.org/10.1016/j.erss.2018.07.034.
[23] G.F. Lowenstein, E.U. Weber, C.K. Hsee, N. Welch, Risk as feelings., Psychological Bulletin. 127 (2001) 267.
[24] H.A. Simon, Models of bounded rationality: Empirically grounded economic reason, MIT press, 1997.
[25] P. Slovic, Perception of risk, Science 236 (4799) (1987) 280–285, https://doi.org/10.1126/science:3563507.
[26] P. Slovic, M.L. Finucane, E. Peters, D.G. MacGregor, Risk as analysis and risk as feelings: some thoughts about affect, reason, risk, and rationality, Risk Anal. 24 (2) (2004) 311–322, https://doi.org/10.1111/j.0272-4332.2004.00433.x.
[27] G. Böhm, H.-R. Pfister, Action tendencies and characteristics of environmental risks, Acta Psychol. 104 (3) (2000) 317–337, https://doi.org/10.1016/S0001-6918(00)00035-4.
[28] G. Böhm, Emotional reactions to environmental risks: consequentialist versus ethical evaluation, J. Environ. Psychol. 23 (2003) 199–212.
[29] N.M.A. Huijts, E.J.E. Molin, L. Steg, Psychological factors influencing sustainable energy technology acceptance: a review-based comprehensive framework, Renew. Sustain. Energy Rev. 16 (1) (2012) 525–531, https://doi.org/10.1016/j.rser.2011.08.018.
[30] G. Perlaviciute, L. Steg, N. Contzen, S. Roeser, N. Huijts, Emotional responses to energy projects: Insights for responsible decision making in a sustainable energy transition, Sustainability. 10 (2018) 2526.
[31] M.L. Finucane, E. Peters, P. Slovic, in: Emerging Perspectives on Judgment and Decision Research, Cambridge University Press, 2003, pp. 327–364, https://doi.org/10.1017/CBO9780511609978.012.
[32] J.S.B.T. Evans, Dual-processing accounts of reasoning, judgment, and social cognition, Annu. Rev. Psychol. 59 (1) (2008) 255–278, https://doi.org/10.1146/annurev.psych.59.103006.093629.
[33] J.S.B.T. Evans, in: In two minds: Dual processes and beyond, Oxford University Press, 2009, pp. 33–54, https://doi.org/10.1093/acprof:oso/9780199230167.003.0002.
[34] A. Glöckner, C. Witteman, Beyond dual-process models: a categorisation of processes underlying intuitive judgement and decision making, Think. Reason. 16 (1) (2010) 1–25, https://doi.org/10.1080/13546780903395748.
[35] D. Kahneman, Thinking, fast and slow, Macmillan, 2011.
[36] T. Brosch, M.K. Patel, D. Sander, Affective influences on energy-related decisions and behaviors, Front. Energy Res. 2 (2014), https://doi.org/10.3389/fenrg.2014.00011.
[37] N. Cass, G. Walker, Emotion and rationality: the characterisation and evaluation of opposition to renewable energy projects, Emot. Space Soc. 2 (1) (2009) 62–69, https://doi.org/10.1016/j.emospa.2009.05.006.
[38] B. Sütterlin, M. Siegrist, Public acceptance of renewable energy technologies from an abstract versus concrete perspective and the positive imagery of solar power, Energy Policy 106 (2017) 356–366, https://doi.org/10.1016/j.enpol.2017.03.061.
[39] H.B. Truelove, Energy source perceptions and policy support: Image associations, emotional evaluations, and cognitive beliefs, Energy Policy 45 (2012) 478–489, https://doi.org/10.1016/j.enpol.2012.02.059.
[40] J. Cousse, R. Wüstenhagen, N. Schneider, Mixed feelings on wind energy: affective imagery and local concern driving social acceptance in Switzerland, Energy Res. Social Sci. 70 (2020) 101676, https://doi.org/10.1016/j.erss.2020.101676.
[41] G.L. Clore, A. Ortony, M.A. Foss, The psychological foundations of the affective lexicon, Journal of Personality and Social Psychology. 53 (1987) 751–766. https://doi.org/10.1037/0022-3514.53.4.751.
[42] V.C. Ottati, E.J. Riggle, R.S. Wyer, N. Schwarz, J. Kuklinski, Cognitive and affective bases of opinion survey responses., Journal of Personality and Social Psychology. 57 (1989) 404–415. https://doi.org/10.1037/0022-3514.57.3.404.
[43] E. Peters, P. Slovic, Affective asynchrony and the measurement of the affective attitude component, Cogn. Emot. 21 (2) (2007) 300–329, https://doi.org/10.1080/02699930600911440.
[44] M. Rohse, R. Day, D. Llewellyn, Towards an emotional energy geography: Attending to emotions and affects in a former coal mining community in South Wales, UK, Geoforum 110 (2020) 136–146, https://doi.org/10.1016/j.geoforum.2020.02.006.
[45] J.S. Lerner, D. Keltner, Fear, anger, and risk., Journal of Personality and Social Psychology. 81 (2001) 146.
[46] N.M.A. Huijts, The emotional dimensions of energy projects: Anger, fear, joy and pride about the first hydrogen fuel station in the Netherlands, Energy Res. Soc. Sci. 44 (2018) 138–145, https://doi.org/10.1016/j.erss.2018.04.042.
[47] S. Dohle, C. Keller, M. Siegrist, Fear and anger: antecedents and consequences of emotional responses to mobile communication, J. Risk Res. 15 (4) (2012) 435–446, https://doi.org/10.1080/13669877.2011.636835.
[48] M. Jobin, M. Siegrist, We choose what we like – Affect as a driver of electricity portfolio choice, Energy Policy 122 (2018) 736–747, https://doi.org/10.1016/j.enpol.2018.08.027.
[49] H. Lavine, C.J. Thomsen, M.P. Zanna, E. Borgida, On the primacy of affect in the determination of attitudes and behavior: the moderating role of affective-cognitive ambivalence, J. Exp. Soc. Psychol. 34 (4) (1998) 398–421, https://doi.org/10.1006/jesp.1998.1357.
[50] Lawrence Berkley National Labs, National Survey of Attitudes of Wind Power Project Neighbors Data, (2018). https://emp.lbl.gov/projects/wind-neighbor-survey (accessed February 24, 2020).
[51] T.R. Haac, K. Kaliski, M. Landis, B. Hoen, J. Rand, J. Firestone, D. Elliott, G. Hübner, J. Pohl, Wind turbine audibility and noise annoyance in a national U.S. survey: individual perception and influencing factors, J. Acoust. Soc. Am. 146 (2) (2019) 1124–1141, https://doi.org/10.1121/1.5121309.
[52] D.A. Dillman, J.D. Smyth, L.M. Christian, Internet, phone, mail, and mixed-mode surveys: the tailored design method, John Wiley & Sons, 2014.
[53] J. Firestone, B. Hoen, J. Rand, D. Elliott, G. Hübner, J. Pohl, Reconsidering barriers to wind power projects: community engagement, developer transparency and place, J. Environ. Plann. Policy Manage. 1–17 (2018).
[54] G. Solon, S.J. Haider, J.M. Wooldridge, What are we weighting for? J. Hum. Resour. 50 (2) (2015) 301–316, https://doi.org/10.3368/jhr.50.2.301.
[55] G. Hübner, J. Pohl, B. Hoen, J. Firestone, J. Rand, D. Elliott, R. Haac, Monitoring annoyance and stress effects of wind turbines on nearby residents: A comparison of U.S. and European samples, Environ. Int. 132 (2019) 105090, https://doi.org/10.1016/j.envint.2019.105090.
[56] J.S. Lerner, D. Keltner, Beyond valence: Toward a model of emotion-specific influences on judgement and choice, Cogn. Emot. 14 (2000) 473–493.
[57] A. Rinscheid, R. Wüstenhagen, Divesting, fast and slow: affective and cognitive drivers of fading voter support for a nuclear phase-out, Ecol. Econ. 152 (2018) 51–61, https://doi.org/10.1016/j.ecolecon.2018.05.015.
[58] B.K. Sovacool, The cultural barriers to renewable energy and energy efficiency in the United States, Technol. Soc. 31 (4) (2009) 365–373, https://doi.org/10.1016/j.techsoc.2009.10.009.