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Intention to Respond to Local Wind Turbines: The Role of Attitudes and Visual Perception

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Wind power projects frequently face public opposition during the siting process. A deeper understanding of social factors has therefore been called for. Based on psychological theories, the present research was initiated in order to study the relative importance of individual aspects related to visual perception and attitudinal factors in public intention to oppose local wind turbines. In an empirical study, 80 people assessed the visual characteristics of wind turbines on site and rated their emotional state. They also completed a questionnaire covering attitudes towards the turbines, perception of significant others' opinions of local wind turbines, and perceived possibilities to oppose as well as intention to oppose local turbines. Moreover, socio-demographics, factors related to the place of residence and general attitude towards wind power, were investigated. In a multiple regression analysis explaining 50% of the variance, it was found that intention to oppose was related to only a few perceptual and attitudinal factors, i.e. the perceived unity of the environment, the personal attitude towards the effects of wind turbines on landscape aesthetics and recreation, and the general attitude towards wind power. Of minor importance was the attitude towards the effects of wind turbines on people's daily quality of life. It seems important to involve the public in the discussion of how wind power installations can be integrated into the landscape without threatening the visual beauty and the recreational value of the natural and cultural environment. Moreover, social intervention is required to promote positive attitudes towards wind turbines. Copyright © 2007 John Wiley & Sons, Ltd.

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Introduction

The public in the USA, Canada and several European countries, including Sweden, generally expresses favourable attitudes towards wind energy.[1–6] These general attitudes are, however, not likely to be directly linked to the acceptance of local wind power projects. In practice, wind power projects on-shore as well as off-shore frequently face resistance from the public in the siting and permitting processes.[7] At an early stage, it was recognized that in order to make wind power development more effective, greater effort must be devoted to improving public attitudes and the perceived aesthetic quality of wind turbines.[8,9] Moreover, institutional and psychological factors must be taken more seriously.[10] There has been an increased interest in identifying social factors in public opposition to local wind power projects. Recent empirical studies have taken a

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societal perspective on the importance of, for instance, political and institutional factors for successful implementation of wind power installations.[11–14] Other studies illuminate individual residential perspectives on the localization of turbines.[5,6,15,16] The present research focuses on the individual resident and was initiated to elaborate previous knowledge of the role of perceptual and attitudinal factors in public response to local wind turbines.[2,17] The study departed from common arguments, tending to be of an environmental and technological character, in the Swedish public debate regarding developments of wind turbines on-shore. The main objective was to investigate the relative importance of visual perception and attitudinal factors in relation to the public's intention to oppose additional turbines in their local area. The research is founded on psychological theories of environmental perception, and on the attitude–behaviour relationship. An overview of previous research is given below, after which the theoretical foundations, the methods and the results of this empirical case study are described.

Previous Research

The most comprehensive empirical study done so far on public opposition to wind turbines has been carried out by Wolsink,[3] who proposed and empirically tested a theoretical model. Wolsink found that people's perceived visual intrusion from the wind turbines, and their perception of wind power as a clean source of energy, partly predicted their attitude towards wind power. Moreover, the attitude, the perceived visual intrusion, and the perceived annoyance in terms of noise and negative effects on birds, predicted resistance. The NIMBY inclination (i.e. a positive attitude towards wind power in general but a negative attitude towards wind power 'in my backyard') and perceived self-efficacy to take political action, were predictors of minor importance. Together, the individual differences in the investigated factors could explain 46% of the statistical variance between the participants' reported opposition. It is worth noting that the perceived visual intrusion in the landscape from the turbines had a considerable impact in this study. Visual intrusion has also been identified as one of the most problematic aspects of local turbines among the public in Sweden, as well as in other countries.[4,5,18] Both positive and negative aesthetic perceptions seem to have a strong influence on public view of wind turbines.[19] Thayer and Hansen[9] concluded in a mail study based on photographs of a large-scale wind energy development, that those who expressed strongly positive attitudes towards the development seemed to focus on the symbolic attributes of wind power, such as environmental considerations, whereas those who expressed negative attitudes stressed the visual characteristics, such as 'clutter' and the unattractiveness of the turbines. Based on Simon's work (1996), Krohn and Damborg[2] stated that acceptance of wind power is based on beliefs about the benefits of wind *energy*, whereas resistance is largely based on beliefs about negative effects of wind *turbines*. Although the literature mainly has focused on the negative visual impacts of turbines, Devine-Wright says '. . . there is little evidence that wind turbines are universally perceived as ugly' (p. 128).[17] People's behaviour is influenced by social norms, and consequently public opinion towards wind turbines may be affected by local social influences, such as a person's social network of family, friends and neighbours.[17] Moreover, public participation in the planning process of wind power projects seems to increase acceptance of local turbines. Khan[11] found in a comparison of wind power planning in three Swedish municipalities that the success of the siting process was related to how the public was approached. Krohn and Damborg[2] concluded that information and dialogue provide the best path to acceptance. Lange and Hehl-Lange[16] successfully introduced an interactive visualization tool in the participatory process of a new development, depicting the planned turbines from the residents' perspectives. Wolsink[20] argued that negative reactions towards local turbines may be an expression of a poor implementation process rather than a NIMBY-reaction, and that people's less positive view of wind turbines in their local environment had become negative during the process. Although the NIMBY framework may highlight some aspects of public resistance to local turbines, recent studies indicate that residential reactions to local turbines cannot be fully explained by the concept of NIMBY.[2,3,17] Several studies find that those who live closest to the planned development are the most positive, at least once the turbines have been built.[6,19] Local involvement in economic terms (e.g. community benefits and shareholding) also seems likely to have favourable effects on public acceptance of local turbines.[17] Furthermore, personal attachment to the local environment may play a role.[15]

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The Perception of the Landscape

The perception of an environment consists of several components, such as spatial and structural parts, but the formal and visual expressions of the environment are also important.[21] Within the area of environmental psychology, interaction models have been developed describing the importance of different environmental aspects on the way in which the environment is perceived. One such model concerns the arousal value of the single experience (unique arousal), i.e. how much the experience activates the individual.[22] According to this model, the experience is affected by the number of arousal-triggering elements. Berlyne[22] suggests that this is happening in accordance with certain patterns, where more arousal-triggering elements lead to more positive feelings up to a certain level. If this level is exceeded, the experience will be less positive and finally will become negative. Küller[23,24] has further developed Berlyne's thoughts in the Human–Environment Interaction model (the HEI model), which is based on a four-step basic emotional process linked to the neuropsychological operation of the central nervous system. The process includes the following components: *activation* (the strength of the emotion), *orientation* (how directed the emotion is), *evaluation* (the hedonic tone of the emotion) and *control* (control of the situation). Specific emotions may be seen as combinations of different levels of those four components, and the emotional state at a specific time may colour the environmental perception.[25] The experience of the environment per se can be described in terms of eight dimensions, including perceived pleasantness, complexity, unity, enclosedness, potency, social status, affection and originality (further described in Table I).[23] The evaluation of the environmental experience is dependent on certain visual criteria. Previous research has shown that environments where the individual objects are perceived to fit well together (to have a high degree of unity) are generally perceived more favourably than environments with a low degree of unity.[26] To summarize, the perception of the environment is seen as an active process involving both external factors (environment) and internal ones (the emotional state). The HEI model has previously been applied in relation to the perception of objects in urban as well as rural environments.[27–29]

The Relation between Attitude and Behaviour

An attitude can be defined as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor' (p. 1).[30] This would seem to imply that we have only one attitude towards any given object or issue. It has been shown, however, that we may evaluate the same object differently in different contexts depending on perspective, i.e. a person can have different attitudes towards the same object.[31] Attitudes serve a variety of purposes for the individual, e.g. they affect judgements. Attitudes seem to bias our processing of information and our memory in favour of attitude-consistent material. Furthermore, negative information tends to have a greater impact on overall evaluations than positive information does. Once we have formed strong attitudes, they tend to be relatively stable over time, to be resistant to persuasion, and to predict behaviour. Several theories have been proposed to describe the connection between attitudes and behaviour. One of them is the Theory of Planned Behaviour (TPB).[32] According to the TPB, people act in accordance with their intentions, which summarizes the motivational forces influencing the enactment of a particular

Table I. Description of the physical environment according to the eight dimensions of the SED (after Küller[23])

Factor	Definition
1. Pleasantness	The pleasantness, beauty and security which the individual experiences in the environment
2. Complexity	The environment's liveliness and complexity
3. Unity	How well the various components in the environment fit, and function together
4. Enclosedness	The closedness and degree of demarcation
5. Potency	The intrinsic, potential force in the environment
6. Social status	The evaluation of the environment in economic and social terms
7. Affection	An age aspect of the environment as well as a feeling of recognition for the old and genuine
8. Originality	The unusual and surprising in the environment

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kind of behaviour. Sometimes, a certain act is not under volitional control, and therefore the behaviour is also thought to be the result of the perceived control, i.e. a person's beliefs regarding control over factors that may facilitate or impede a certain kind of behaviour. Intentions are in turn influenced by (i) attitudes, which reflect a person's feelings of favourableness or unfavourableness towards the particular behaviour; (ii) subjective norms, which reflect a person's perception that significant others such as family and friends, etc., desire the individual to behave in a certain way; and (iii) perceived control. This means that perceived control will influence behaviour, both directly and indirectly, via the intention. Support for the theory in general has been summarized in meta-analyses and a review of the literature.[33,34] The TPB is one of the most frequently applied theories to explain pro-environmental behaviour among the public, such as water conservation, waste management and choice of travel mode.[35]

Attitude theory implies that people's attitudes towards wind power as such might differ from their attitudes towards turbines in their local environment, because the objects of their evaluations are completely different. The theory also suggests that one person may hold several attitudes at the same time towards wind turbines in the local environment, depending on what aspects of the turbines are considered. As described above, previous research has identified several factors related to the physical and environmental aspects of turbines that people may have attitudes towards. However, this research has not considered people's attitudes towards the effects that local wind turbines can have on the perceived personal quality of life (QoL). QoL is a multidimensional construct and may be defined as the extent to which people's important needs and values are fulfilled.[36] People are thought to pursue a number of objectives to maintain or improve their well-being, in terms of social relations, pleasure, work, health, privacy, money, status, safety, nature, leisure time, justice, etc. Environmental factors such as noise, shadows or flicker from a wind turbine may or may not be perceived by the individual as threatening these objectives. The QoL aspects were initially proposed by Gatersleben and Vlek[36] to identify possible social and psychological barriers to developing sustainable household consumption patterns, but some of the aspects have been used to explain other pro-environmental behaviours.[37,38]

Objectives and Hypotheses

The main objective of the present research was to study the relative importance of visual perception as opposed to attitudinal factors and personal background in relation to public intention to oppose local wind turbines. The questions asked were: When considering wind turbines in the landscape context, which of the HEI model's perceptual dimensions are related to a negative visual impact of turbines? Which TPB factors may be linked to intention to oppose local turbines? And, how important are the perceptual dimensions as opposed to TPB factors and personal background factors to public intention to oppose turbines in their local environment?

It was hypothesized that the perceptual experience of wind turbines would influence intention to oppose. It was expected that those who perceived the turbines to have a high degree of unity with the landscape would express a low degree of intention to oppose. No directed hypotheses were formulated in relation to the other perceptual dimensions. It was further hypothesized that people with a more positive emotional state would have a more favourable perception.

In relation to the TPB, it was expected that people who expressed favourable attitudes towards various effects of wind turbines (attitude), who perceived significant others to have a positive opinion of local turbines (subjective norm) and who also thought that they had the possibility to oppose in public or to influence the planning process (perceived control), would be less likely to intend to oppose local turbines.

It was further assumed that background factors, such as general attitude towards wind power, residential environment and socio-demographics, would affect intention to oppose. More specifically, it was hypothesized that people with a favourable general attitude would be less likely to intend to oppose turbines. Concerning the residential factors, it was expected that the distance between the home and the turbines would have an influence. Those who did not have a view of the turbines from their home, and who in general were happy with their residential environment and had lived for a long time in their residential area (and were thus more likely to have developed place attachment), would be less likely to express an intention to oppose.

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Method

Choice of Installation

The installation was chosen from a number of criteria, developed together with the County Administrative Board in Skåne (the authority responsible for permits).

- The establishment should be located in the region of Skåne, an area already identified as suitable for further wind power development.[39]
- There should be more than one turbine, since future developments are likely to involve groups of turbines.
- The design should be reasonably representative of turbines built in Sweden in the last decade.
- A few years should have passed since construction, to avoid 'the novelty effect'.
- In order to avoid extreme feelings, the siting process should not have been the subject of major conflict.
- In order to obtain a sample of local residents, the turbines should be located no further than 3 km from a residential area of at least 500 inhabitants.

These criteria were fulfilled by an installation at Gislövs Läge, an old fishing village that has developed into a residential area close to Trelleborg, a town of 25,000 inhabitants on the south coast of Sweden. The installation consists of two white NEG Micon turbines of 750 MW each, built in 1998 (turbine height 50 m, rotor diameter 48 m, yearly production since the start 1200–1800 MWh) and 2002 (turbine height 50 m, rotor diameter 44 m, yearly production 1900 MWh). The development is owned by a local farmer (Figure 1). The turbines are sited in the inland agrarian landscape, which consists of large, flat fields of fertile soil. The area has been affected by agricultural activities since the Stone Age and there are many ancient remains. The cultural heritage can also be seen in the small medieval villages and farms surrounded by large trees scattered throughout the landscape. A road forms a barrier between the agrarian fields where the turbines are sited and the residential areas and beaches at Gislövs Läge.

The Participants and Their Background

The sample included 80 residents (44 females and 35 males, 1 person did not report gender) between 20 and 83 years of age (mean age 44 years). It represented people of different educational levels and a wide range of professional areas (e.g. care and education, IT and the financial sector), as well as students (5%), and retired (10%) and unemployed (10%) people. On average, the participants had lived 13 years in their present residence, and a majority found their residential environment pleasant (26%) or very pleasant (67%). Twenty-one

Figure 1. The turbines assessed in Gislövs Läge, Sweden

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Table II. Participants divided into three groups according to how close to the turbines they lived. One person did not give any background information

	Gislöv	Trelleborg	Skåne
Total (*n*)	32	24	23
Females (*n*)	18	14	12
Males (*n*)	14	10	11
Mean age (years)	51	38	43

percent could see a wind turbine from their residence. The participants could be divided into three groups according to how close to the turbines they live (Table II). The participants from Gislövs Läge live within 3 km of the turbines. The participants from Trelleborg approximately 3–5 km away could see the turbines from the town, but did not have a direct view from their homes. The participants in the third group live within the region of Skåne (up to 50 km from the installation). Fifty-seven percent expressed a favourable general attitude towards wind energy, whereas 37% were hesitant or negative (7% did not express a view).

Procedure

Participants from Gislövs Läge and Trelleborg were recruited via advertisements and information sent out by the municipality, reaching all households within the area. Furthermore, the research team arranged for information to be distributed directly to households at Gislövs Läge, as well as via non-governmental organizations and the local school at Gislövs Läge. Additional participants from Trelleborg were recruited via an adult education programme. Participants outside the area constituted a convenience sample including university students, work colleagues, and their families and friends.[40] The information provided described the research as a study on public perception of wind turbines. Participation was voluntary and those who wished to take part were asked to meet at the school at Gislövs Läge to answer questionnaires on one of three occasions (one weekday and two Saturdays). At a meeting point outdoors, with a clear view of the turbines, the participants were first asked to complete perceptual assessments of the turbines in the landscape. Assessments were made only in fair weather. Immediately afterwards, the participants assessed their own emotional state. They were then invited indoors to answer another questionnaire concerning attitudinal factors. The participants who returned completed questionnaires participated in a lottery with prizes of books. The whole procedure took approximately 30 min.

Instruments

The perceptual characteristics of the wind turbines in the landscape were assessed using the semantic environment description (SED).[23] This assessment consists of 36 semantic scales, and the results yield an eight-factor profile of the environment (Table I). It has been shown to be possible to relate the perceptual SED profile to specific characteristics of the physical environment.[23] The internal consistency varies between 0.71 and 0.86 for the different factors, and the test-retest reliability (as measured by Pearson r) varies between $r = 0.66$ and $r = 0.84$. Groups of 20 subjects normally yield stable results and the instrument has proven to be stable under different weather conditions and seasons.[41]

The emotional state was assessed in terms of four basic emotional qualities each measured by three four-grade rating scales: activation (e.g. alert/sleepy), orientation (e.g. interested/bored), evaluation (e.g. happy/sad) and control (e.g. confident/hesitant).[23] The four basic emotional qualities can be treated as four separate indices or as a total measure. The latter method was employed in the present study. The internal consistency of the total measure has been estimated to give a value of Cronbach's $\alpha = 0.82$.[42]

The attitudinal aspects were assessed by a questionnaire developed in line with the constructs of the TPB, which usually yields a high level of reliability.[43] Throughout the questionnaire, responses were given on 5-point Likert scales. The specific attitudes towards the effects of wind turbines on the local environment were

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measured by 15 items as seen in Table III. The scale was '1' = very negative, to '5' = very positive. Moreover, 14 items concerned the attitude towards the effects of the turbines on the personal QoL, with the same response scales as above. The exact wordings of these items can be found in Table V.

The subjective norm, defined as beliefs about significant others' opinions of local wind turbines and the perceived importance to oneself of each one of these people's opinion, was measured with seven items: What opinion do you think 'nn' in your vicinity have towards the establishment of wind turbines similar to those you previously assessed? In the various items, 'nn' was replaced by (i) your family, (ii) close friends, (iii) friends and acquaintances, (iv) work colleagues, (v) neighbours, (vi) people in your town and (vii) well-known figures in your home town. Answers were given on the same scale as above. These answers were weighted according to the perceived importance to oneself: '1' = nothing at all, to '5' = very much.

Perceived control, defined as the perceived possibility to oppose in public and to influence the planning process of local wind power projects, was measured with seven items: If you want to be involved in the establishments of additional wind turbines in your local environment, how do you assess your opportunities to (i) obtain information about the development, (ii) express your opinion in public, (iii) initiate a public debate, (iv) get involved in the planning process, (v) influence the location of the turbines, (vi) appeal against the decision to the County Council and (vii) influence the operation of the turbines? The response scale was '1' = very difficult, to '5' = very easy.

The intention to oppose additional local wind turbines was measured by six items referring to various actions. How would you react if new, similar turbines were established near your home? (i) I would approve of it without question; (ii) I would approve of it if it did not have any negative effects on me and my family; (iii) I would argue against it in the local paper; (iv) I would demonstrate against it; (v) I would sign petitions against it; or (vi) I would appeal against it at the County Council. Response scale was '1' = very unlikely, to '5' = very likely. Note that the first two items are coded in the opposite direction to the others.

The questionnaire also contained questions on socio-demographics (gender, age, educational level). The respondents' residential environment was considered by the following items: (i) How many years have you lived in your present home; (ii) How pleasant do you find your residential environment: '1' = very good, to '5' = very bad; and (iii) Can you see any wind turbines from your home (no, part of the year, yes). The general attitude towards wind power was rated as '1' = very negative, to '5' = very positive.

Data Processing

In order to obtain as large a number of participants as possible in the different analyses, a few missing values for individual items in the SED (3 values), the emotional state (4 values), the measures of specific attitudes (3 values), subjective norm (4 values), perceived control (2 values), intention to oppose (1 value) and the general attitude towards wind power (6 values), were replaced by the sample mean values. Missing data in socio-demographics were not replaced. Data were analysed by parametric statistical analyses in the SPSS, Statistical Package for the Social Sciences for Windows, version 10.[44] Factor analysis was carried out with the objective of reducing the number of variables and identifying possible underlying dimensions of the TPB constructs. In these analyses, orthogonal and oblimin rotations gave identical solutions. Based on the assumption that the different TPB factors might be related, the results of the oblique solutions are reported. Multiple regression analyses were performed in order to identify relations between the SED dimensions, TPB factors and background factors on the one hand, and the intention to oppose turbines on the other. Intention was treated as the dependent variable and the others as independent variables. Sample sizes above 60 subjects are acceptable for multiple regression.[45] The p-value, however, is likely to be a poorer approximation in relatively small samples; therefore, the criterion for significance was set to the recommended $p = 0.01$.[45]

Results

Visual Perception

The results of measures of central tendency [mean value (M)] and dispersion [standard deviation (SD)] of the eight SED factors show that the landscape with the turbines is neither very pleasant nor very unpleasant. It is

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Table III. Oblique factor analysis of attitudes towards possible effects of wind turbines. The interpretation of the factors is based on the variables with the highest loading in the factor. Variables not used in the interpretation are presented in italics

What is your opinion of the following effects of wind turbines like the ones you have just assessed? (very negative–very positive)	Factor I	Factor II	Factor III
Changes in the landscape	*0.59*	*0.39*	–0.81
Changes in the view	*0.59*	*0.45*	–0.87
Changes in the ambient noise level	0.73	*0.42*	*–0.41*
Formation of shadows	0.67	*0.38*	*–0.25*
Effects on the value of land and property in the vicinity	0.68	*0.27*	*–0.36*
Changes in the conditions for small animals	0.78	*0.39*	*–0.42*
Effects on birds	0.79	*0.07*	*–0.37*
Effects on radio and TV transmissions	0.74	*0.22*	*–0.34*
Effects on valuable natural areas	*0.46*	*0.37*	–0.76
Changes in opportunities for recreation	*0.24*	*0.45*	–0.81
Possibility for the production of 'green' electricity	*0.11*	0.56	*–0.40*
Changes in the opportunity to use agricultural land in the area	*0.42*	0.82	*–0.32*
Future opportunities to build roads and railways	*0.32*	0.80	*–0.30*
Conditions for military activities	*0.28*	0.74	*–0.40*
Conditions for local industries	*0.28*	0.75	*–0.50*
Proportion of total variance (60.78%)	41.82%	11.67%	7.28%

Table IV. Means (M), SDs and reliabilities for the five attitude indices

Attitude	M	SD	Cronbach's α
Physical environment and wildlife	2.74	0.59	0.83
Aesthetics and recreation	2.74	0.80	0.85
Society	3.30	0.62	0.80
Daily QoL	3.33	0.73	0.94
Personal health	3.35	0.78	0.90

perceived as rather open, and the relation between complexity and unity is well balanced. The originality is somewhat low, which shows that the turbines are seen as a natural part of the environment. The perceptual profile can be seen in Figure 2.

The SED factors were also analysed in relation to the participants' emotional state. This index that is based on 12 items can vary between one and four. The mean value 3.18 (SD = 0.39) indicates that the participants on average were in a rather positive emotional state. The internal consistency of the index was estimated by Cronbach's α; the α-value of 0.86 being well above the recommended acceptable level of 0.70.[46] Indeed, modest but significant correlations, as calculated by the correlation coefficient Pearson r, were found for emotional state/environmental unity ($r = 0.28$, $p = 0.01$) and for emotional state/environmental potency ($r = 0.34$, $p = 0.002$).

Attitudinal Aspects

In the factor analyses of the 15 scales covering the effects of wind turbines, three factors with eigenvalues above 1 were obtained (Table III). The first factor, which was based on six items, expressed the attitude towards

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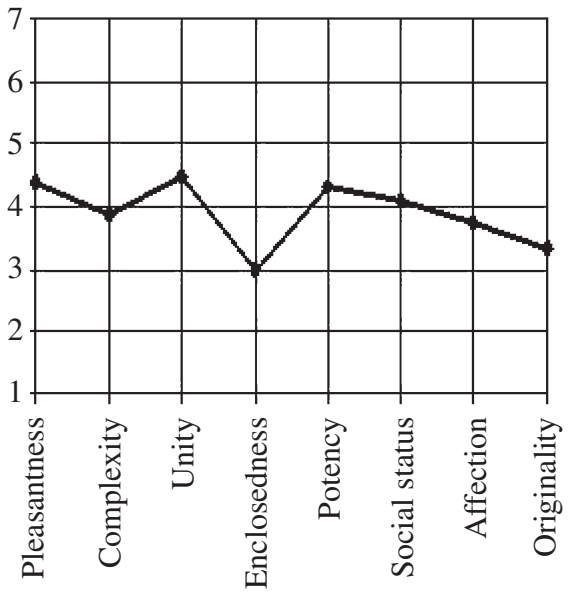

Figure 2. Mean values of the eight factors of the SED illustrated in an SED profile

the effects on the close physical *environment and wildlife*, i.e. shadows, noise, and effects on birds and other small animals. The second factor, which covered five items, described the attitude towards the effects on *society*, including land-use, military activities, business and the production of 'green' electricity. The third factor embraced four items and expressed the attitude towards effects on landscape *aesthetics and recreation*. Three indices corresponding to the three factors were constructed by adding the participants' scores for the items included in the factor and then dividing the sum by the number of items. The participants' scores for the three indices could vary between 1 (a very negative attitude) and 5 (a very positive attitude). The attitudes towards the effects on the environment and wildlife and towards aesthetics and recreation were slightly negative (Table IV).

A similar factor analysis was carried out, including the 14 items that covered the attitude towards the effects of wind turbines on the personal QoL. In this analysis, two factors were obtained (Table V). The first factor concerned the *daily* QoL, and the second factor concerned QoL aspects related to *personal health*. Two corresponding indices were obtained by adding the participants' scores for the items included in the factor and dividing the sum by the number of items. The participants' scores for these indices could vary between 1 (a very negative attitude) and 5 (a very positive attitude). Both attitudes were slightly positive and the reliability of the indices was high (Table IV).

As suggested by Ajzen,[43] the other TPB measures (subjective norm, perceived behavioural control and intention) were also analysed as composite measures. The answers for the seven items covering subjective norm were recoded into a scale from −2 to +2, negative values representing a negative opinion, positive values representing a positive view, and 0 indicating a neutral opinion. The answers were then weighted from 1 to 5 according to the perceived importance to oneself of the opinion of each group of people. The obtained values were subjected to a factor analysis that revealed only one dimension of the participants' *perception of significant others' opinion* of local wind turbines. An index score was calculated by adding the value of the items and dividing the sum by seven. The index score could vary between −10, indicating a negative influence from significant others, and +10 indicating a positive influence. The unidimensionality of the measure was confirmed by the high internal reliability. The sample mean and SD show that the sample included people who were likely to perceive significant others to be positive as well as people who perceived them to be negative towards local wind turbines (Table VI).

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Table V. Oblique factor analysis of attitudes towards the effects of wind turbines on the quality of life. The interpretation of the factors is based on the variables with the highest loading in the factor. Variables not used in the interpretation are presented in italics

How would the construction of wind turbines in your vicinity affect you regarding the following? (very negative–very positive)	Factor I	Factor II
Feeling safe in your home and residential area	*0.54*	0.83
Enjoyment of nature and the beauty of the cultural landscape	*0.44*	0.87
Good health	*0.60*	0.78
Having access to clean air and water and uncontaminated land	*0.60*	0.66
Living a life with positive experiences and challenges	*0.72*	0.83
Having good quality leisure time and being able to do what you like to do	0.79	*0.69*
Having the same opportunities and rights as others	0.89	*0.61*
Being in beautiful surroundings	*0.66*	0.88
Maintaining good relations with friends, neighbours and colleagues	0.82	*0.67*
Having a problem-free, convenient daily life	0.83	*0.68*
Having access to natural environments, with a diversity of plants and animals	0.75	*0.64*
Being able to find a job	0.91	*0.44*
Having a varied life full of different kinds of experiences	0.93	*0.53*
Having access to a secluded, peaceful place	0.86	*0.59*
Proportion of total variance (72.31%)	63.45	8.85

Table VI. Results of oblimin factor analyses of items related to subjective norm, perceived behavioural control and behavioural intention, and description of the corresponding indices

Indices	Factor loadings range	Proportion of variance (%)	M	SD	Cronbach's α
Subjective norm					
Perceived opinion of sign. others	0.56–0.86	57	0.87	2.10	0.87
Perceived behavioural control					
Poss. to oppose in planning process	0.74–0.89	45	2.15	0.87	0.84
Poss. to oppose in public	0.63–0.87	20	2.92	0.79	0.65
Behavioural intention					
Intention to oppose	0.45–0.73	62	2.20	0.87	0.87

The factor analysis of the seven items referring to the participants' perceived behavioural control revealed two dimensions. The first factor pertained to the *possibility to influence the planning process* and included four items (to get involved in the planning process, to influence the location, to appeal against the decision and to influence the operation of the turbines). Factor two described the *possibility to express oneself in the public sphere* (to obtain information about the development, to express personal opinion in public and to initiate a public debate). The participants' scores for the factors were computed by adding the values of the items included in the factor and then dividing the sum by the number of items. The score for the indices could vary between 1 (indicating that opposition was perceived as very difficult) and 5 (indicating that opposition was perceived as very easy). In general, expressing opposition in the planning process and in the public debate was perceived as difficult (Table VI).

The index computed for *intention to oppose local wind turbines* was based on a factor analysis of six items (described under Instruments section). The analysis revealed one dimension only of intention. The participants' scores were obtained by adding the values of the six items and dividing the sum by six. The index score could vary between 1 (intended opposition very unlikely) and 5 (intended opposition very likely). The mean value indicates that most participants did not intend to oppose the establishment of similar land-based turbines (Table VI).

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Identifying Predictors of Intention to Oppose Local Turbines

In order to improve the understanding of factors behind public resistance to local wind turbines, hierarchical multiple regression analyses were carried out with *intention to oppose local turbines* as the criterion variable.[44] In this method, commonly employed in the field of environmental psychology, theory guides the order in which the predictor variables are entered. To find the most pertinent predictors among the perceptual, attitudinal and background factors, three separate analyses were initially performed with (i) the SED factors and emotional state as predictor variables; (ii) the TPB factors as predictors; and (iii) socio-demographics, residential factors and general attitude towards wind power as predictor variables. To avoid problems of collinearity in the regression analyses (i.e. two or more variables contributing to the same variance), correlation analysis (Pearson r) between the various predictor variables entered in each of the three regressions was first carried out and the strength of the correlation coefficients was scrutinized.

In the first set of regression analyses, emotional state and the eight SED factors were entered as predictors. Emotional state was entered as the only predictor in the first stage and explained 6% of the variance in resistance [$F(1, 78) = 5.68$, $p = 0.02$]. When the SED factors were added in the second stage, the explained variance increased significantly (Table VII). The perceived unity of the environment became the only individual significant predictor. This means that people who perceived a low degree of unity were more likely to oppose additional wind turbines. Table VII presents the β-coefficients when all predictors are entered in the regression.

The second set of regression analyses included the TPB factors. In the correlation analyses, it was found that the attitude towards the effects on personal health was highly positively correlated with several of the other predictor variables, and was therefore excluded from the regression (environment and wildlife: $r = 0.52$, society: $r = 0.51$, aesthetics and recreation: $r = 0.71$, daily QoL: $r = 0.78$, possibility to influence the planning process: $r = 0.51$). Consequently, only four attitude indices were entered as predictors in the first stage of the regression analyses. Together they could explain 35% of the variance in resistance (Table VII). Only two of the attitudes, aesthetics and recreation as well as daily life, independently contributed to the explanation of the variance. The results mean that those who expressed a negative attitude towards the effects of nearby wind turbines on aesthetics and recreation and who also expressed a negative attitude towards the effects of turbines on their daily QoL were more likely to oppose additional turbines. Perception of others' opinions, and the perceived possibility to oppose in public and to influence the planning process were entered in two separate succeeding stages, but neither of them contributed significantly to explaining the variance (Table VII).

The third set of regression analyses dealt with possible relations with socio-demographics, residential factors and the general attitude towards wind power. In the first stage of the hierarchical regression analyses, gender was entered as a dummy variable (1 = female, 2 = male). The second stage consisted of the participants' age, and the third of their educational level. None of these three predictors significantly explained the variance in intention to oppose, neither did the distance of the residence from the assessed turbines (Gislövs Läge, Trelleborg, Skåne), whether the turbines could be seen from the residence, how long the participants had lived there, or the perceived pleasantness of the residence. In the last stage, the general attitude towards wind power substantially increased the explained variance (Table VII). In this stage, pleasantness of residence also became a significant predictor, but of minor importance. The direction of the relationship with general attitude indicates that those who expressed a negative attitude towards wind power in general were also more likely to report a strong intention to oppose turbines (Table VII).

Understanding Intention to Oppose Turbines

In a final multiple regression analysis, the strongest predictor variables of the three regressions above were entered simultaneously into the same regression, in order to control for all other variables in the analysis.[44] As can be seen in Table VIII, a total of 50% of the variance in resistance could be explained. The β-coefficients suggest that the perceived unity is the strongest predictor, closely followed by the attitude towards effects on aesthetics and recreation, and the general attitude towards wind power. The attitude towards the effects on daily life is a weaker predictor and showed a tendency to be significant. An additional regression analysis was

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Table VII. Hierarchical regressions with intention to oppose as criterion variables. In regression I, emotional state and SED factors were entered as predictors. In regression II, the TPB constructs were entered as predictors and in regression III, background variables, i.e. socio-demographics, residential factors and general attitude were entered as predictors. In regression III, *n* is reduced due to missing socio-demographic data

Regression I: intention to oppose, $n = 80$					Regression II: intention to oppose, $n = 80$					Regression III: intention to oppose, $n = 72$				
Variables entered	*B*	*SE B*	β	*p*	Variables entered	*B*	*SE B*	β	*p*	Variables entered	*B*	*SE B*	β	*p*
Emotional state	–0.16	0.24	–0.07		Attitude:					Socio-demographics:				
Perceptual factor:					Environment and wildlife	0.22	0.18	0.15	n.s.	Gender	–0.24	0.19	–0.14	n.s.
Pleasantness	–0.12	0.07	–0.20	n.s.	Society	–0.11	0.17	–0.08	n.s.	Age	0.01	0.01	0.20	n.s.
Complexity	0.004	0.11	0.01	n.s.	Aesthetics and recreation	–0.44	0.16	–0.40	0.009	Education	–0.10	0.10	–0.11	n.s.
Unity	–0.29	0.09	–0.36	0.002	Daily QoL	–0.32	0.13	–0.27	0.013	Residential factors:				
Enclosedness	0.04	0.09	0.05	n.s.	Per. opinion of sign. others	–0.06	0.05	–0.14	n.s.	Distance from turbines	–0.12	0.15	–0.08	n.s.
Potency	–0.13	0.11	–0.14	n.s.	Poss. to oppose in public	–0.03	0.11	–0.03	n.s.	Time in residence	–0.01	0.01	–0.14	n.s.
Social status	–0.02	0.10	–0.02	n.s.	Poss to oppose in planning	0.00	0.12	0.00	n.s.	Pleasantness of env	–0.28	0.14	–0.23	0.047
Affection	–0.02	0.10	–0.02	n.s.						View of turbine	–0.04	0.08	–0.07	n.s.
Originality	0.07	0.10	–0.09	n.s.						General attitude	–0.90	0.18	–0.51	0.000
$R^2 = 0.33$, $R^2adj = 0.24$, F(9, 70) = 3.79, $p = 0.001$					$R^2 = 0.40$, $R^2adj = 0.34$, F(7, 72) = 6.72, $p = 0.000$					$R^2 = 0.36$, $R^2adj = 0.28$, F(8, 63) = 4.37, $p = 0.000$				

Table VIII. Simultaneous multiple regression with intention to oppose as criterion variable and unity, attitude towards the effects on aesthetics and recreation, attitude towards the effects on daily QoL and general attitude to wind power as predictor variables

	Intention to oppose (n = 80)			
Variables entered in equation	*B*	*SE B*	*B*	*p*
Perceptual dimension:				
Unity	–0.23	0.07	–0.29	0.002
Specific attitudes:				
Aesthetic and recreation	–0.29	0.11	–0.26	0.01
Daily life	–0.22	0.12	–0.18	0.06
General attitude towards wind power	–0.48	0.17	–0.26	0.006

$R^2 = 0.50$, $R^2adj = 0.48$, $F(4, 75) = 19.29$, $p < 0.001$.

carried out in which the pleasantness of the residential environment was added, but this predictor did not contribute to the explained variance.

Discussion

Based on psychological theory, i.e. the HEI model[23] and the TPB,[32] the aim of this research was to study the relative importance of visual perception and attitudinal factors in relation to public intention to oppose local wind turbines. The results confirmed those of previous studies, showing that individual factors in public resistance are linked to the visual perception of turbines as well as to personal attitudes. The unique contribution of the present study is the detailed understanding of which individual perceptual and attitudinal factors are the most significant in the intention to oppose turbines. An important result of this study is that rather few of the investigated perceptual and attitudinal factors seem to be critical. The relevant factors identified pertain to the perceived unity of the environment, the personal attitude towards the effects of wind turbines on landscape aesthetics and opportunities for recreation, and the person's general attitude towards wind power. Of minor importance, but still a factor worth considering, is the attitude towards the effects of wind turbines on the personal daily QoL.

The most important factor, in the present study, for reducing public intention to oppose turbines seems to be that the visual characteristics of a group of turbines fit in with the landscape, i.e. that the turbines are perceived to blend in with their surroundings. This is likely to be easier to achieve in an environment where industrial buildings of similar size are already present than in areas where the scenic view is unaffected. The remaining seven visual dimensions covered by the SED (perceived pleasantness, complexity, enclosedness, potency, social status, affection and originality) were not significantly related to public intention to oppose. The participants' emotional state did not directly influence intention. However, the emotional state was partly expressed through the perception of unity, since these variables were correlated. Although the realism of photo montages can be questioned,[47] the present result lends credit to a study in which the turbines were integrated into various real landscapes, very similar to the present situation. Also, this study indicated that the overall perception of the turbines in the landscape was more important than the details of the turbines.[48] In a Swedish study, off-shore locations were considered an environmental improvement while a location in the mountains was considered an environmental deterioration compared to a location on-shore near the coast.[49] Wolsink[3] found that members of an environmental movement in The Netherlands considered industrial areas and military training grounds, where the scenic value of the landscape could hardly be spoiled by turbines, to be suitable for wind power projects. In the same study, the examples provided of poor siting were recreational areas and areas with important cultural remains.

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In the present study, three specific attitude constructs embracing different aspects of wind turbines in society and the local environment were identified. The participants expressed a slightly favourable attitude towards the effects of wind turbines on society, while the attitudes towards the effects on the local physical environment and wildlife and the effects on landscape aesthetics and opportunities for recreation, on average were negative. Aesthetics and recreation was the only one of these three attitudes in the regression analyses that was related to intended opposition. Participants who felt that turbines would have a negative effect on the aesthetics of the landscape and that they would decrease its recreational value, were more likely to have an intention to oppose. The result confirms Wolsink's[3] conclusion that the site chosen will be crucial regarding people's attitudes towards wind power projects. It is interesting to note that although people expressed concerns about the possible effects of turbines on birds and other animals, as well as their own environment in terms of noise, etc., as in many previous studies these concerns were not reflected in intention to oppose.[3,15,18] Furthermore, the attitude towards effects on the personal daily QoL was considered. To the authors' knowledge, this aspect has not been studied in relation to opposition to wind turbines. The introduction of QoL was useful to some degree. The perceived effects on daily QoL significantly predicted intention to oppose in regression II, and a tendency in the same direction was identified in the final regression. These results imply that developers may find it fruitful in the implementation process to consider how local turbines may interfere with people's ability to maintain their personal values and fulfil their needs.

In the TPB, a person's intention to oppose turbines would, to some extent, be predicted by his or her perception of other closely related people's opinions as measured by the subjective norm.[31,32] Accordingly, Devine-Wright[17] proposed that the social network would influence local resistance to wind turbines. The TPB also postulates that a person's perceived control would predict intention and behaviour. Previous research has underlined the importance of public participation in decision making concerning wind power installations.[2,3,11,15,17] In the present study, the weighted perception of others' opinions and the perceived possibility to oppose in public and to influence the planning process did not significantly predict intention to oppose. One explanation of this might be that the investigated site had been subject to rather limited public discussion. It might also be that norms and possibilities to oppose would be more relevant during an ongoing siting process. Another reason might be the operationalization of the constructs, as discussed below.

In addition to the theoretically motivated variables, a number of background factors were investigated, including the general attitude towards wind power, residential factors and socio-demographics. In accordance with previous studies,[1–3,5,6] the participants expressed a favourable general attitude towards wind power, and this was found to be one of the major predictors of intention to oppose. In fact, it accounted for the same amount of explained variance as the attitude towards effects on aesthetics and recreation. The general attitude towards wind energy also partly explained resistance in Wolsink's model.[3] This implies that developers could probably reduce opposition by increasing awareness of the benefits of wind power and by promoting wind energy as a 'green' source of energy before initiating a siting process. The influence of socio-demographics (gender, age and education) and residential factors, which have received much attention, seems negligible. No differences in intention to oppose additional turbines were identified between the three groups who lived at different distances from the existing turbines. The present results are in accordance with the conclusions regarding the insignificance of the proximity hypothesis and the NIMBY inclination,[2,11,17] but neither do they support findings indicating that people who live nearby would be more favourable.[6,19] A tendency was identified for the pleasantness of the residential environment to have an effect on intention to oppose in the analysis of background factors, but this variable did not contribute to explaining the variance in resistance in the final regression. This could mean that people who are in a positive mood will tolerate a greater impact on the physical environment. Neither the location of the residence, the view of turbines from home, nor the time living in the current residence had any effect.

Theoretically, it should be noted that the attitudinal factors investigated were not strictly operationalized according to the TPB, which would have been more closely related to the action of opposition in itself (e.g. attitude towards opposition and perception of other's view of opposition) rather than embracing underlying causes related to the turbines. A strict operationalization would most likely have increased the amount of explained variance in intention, since it would more closely have described the context of overt opposition.

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However, this approach would have shed less light on the importance of those contextual factors discussed in the public debate, and would in this respect have reduced the practical relevancy of the study. Political and institutional factors were outside the scope of the present study. Additional variance of intention to oppose turbines may have been explained if more detail had been provided on, for instance, who would be the developer and potential financial benefits from the development for local residents. The general attitude was included as a background variable, and in order to save participants' time it was measured by a single scale. Methodologically, it would probably be better to apply a composite measure of the general attitude in future studies.

Although the instruments were reliable and easy to use, it was difficult to get people together at a site at certain days and times. Due to the time-consuming procedure and a lack of financial resources, the study was not based on a random sample, which meant that women, the elderly and the unemployed were over-represented in comparison with the general Swedish population. By collecting data during weekends, we were still able to include a substantial number of the working population. The participants also lived in different types of residential areas. It might be argued that individuals holding strong negative opinions would be more likely to participate. In the present study, this was avoided by choosing an establishment that had not been subject to a major conflict and that was a few years old. A majority of the sample held a favourable attitude towards wind energy and were not strongly negative towards the effects of local turbines, irrespective of where they lived. The study should, however, be regarded as a case study rather than a survey of the Swedish population.

To overcome the problems we faced in data collection, it might also be useful to develop methods where people are not required to come to a specific site. One way would be to employ computer-based simulation tools. This technique would also allow for the assessment of the latest technology. There is a wide range of modern visualization techniques for depicting new developments in the landscape, including Geographical Information Systems (GIS)-based tools with 3D representation.[50] It is, however, of outmost importance that these techniques reproduce the appearance of wind turbines realistically as they will be seen from the perspectives of the local residents' daily environments, e.g. their homes as well as places that are frequently visited.[16,51]

The present study was conducted in an agricultural landscape in the proximity of urban residential environments, where wind turbines are already present. It would be desirable to repeat the study in other types of landscapes, e.g. in mountainous areas and for installations off-shore, as well as with larger samples and other cultural contexts. Another topic that merits further attention would be to identify which QoL aspects people consider most important to uphold in relation to wind power developments and which are thus the most urgent for developers to deal with. In this approach, it would be useful to also accommodate for the political and institutional aspects of the development. By applying QoL indicators in simulation studies or before and after studies, it would be possible to estimate how well different measures could maintain people's well-being when wind turbines are introduced in a certain environment.[52]

In conclusion, the study stresses the importance of choosing siting areas not only according to wind potential and environmental factors, but also on aesthetic grounds. Local opposition to wind power projects is likely to decrease if developers initially strive to ensure that the turbines are perceived by the residents to fit in with the surroundings. At the same time, favourable attitudes towards wind power in general, as well as towards environmental and personal effects of local turbines, should be strengthened. It seems particularly important for developers to convince the public that turbines can be integrated into the landscape without threatening the beauty and the recreational value of natural and cultural landscapes. Hand-in-hand with the aesthetic considerations, social interventions are required to promote favourable attitudes.

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