



# Health complaints and wind turbines: The efficacy of explaining the nocebo response to reduce symptom reporting



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## ABSTRACT

**Background:** A number of people are reporting an environmental sensitivity to sub-audible windfarm sound (infrasound), characterised by the experience of recurrent non-specific symptoms. A causal link between exposure and symptoms is not indicated by empirical evidence. Research indicates symptoms may be explained by the nocebo response, whereby health concerns and negative expectations, created from social discourse and media reports, trigger symptom reporting.

**Objective:** The experimental aim was to test whether providing a nocebo explanation for symptoms, to individuals reporting symptomatic experiences during infrasound exposure, would ameliorate symptoms during further exposure.

**Method:** Sixty-six volunteers were randomly assigned to nocebo explanation or biological explanation groups. Participants were concurrently exposed to infrasound and audible windfarm sound, while reporting on current symptoms and mood, during two exposure sessions. Preceding session one, participants watched a presentation integrating media warnings about purported health risks posed by windfarm infrasound. Before session two, nocebo explanation participants viewed material outlining how nocebo responding could explain symptom reporting. Instead biological explanation participants watched material presenting pathophysiological theories for symptoms.

**Results:** During session one, participants reported increased symptoms and mood deterioration from baseline assessment. During session two symptom reporting and mood deterioration was maintained by biological explanation participants, while mood and symptoms reported by nocebo explanation participants returned to baseline levels.

**Conclusion:** Results indicate that providing an explanation of the nocebo response, followed by exposure to infrasound, has the potential to operate as an intervention to reduce symptomatic experiences in people reporting symptoms attributed to windfarm generated infrasound.

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## 1. Introduction

While harnessing wind power is widely considered to be a vital component of global energy policies designed to address climate change, the construction of wind farms has become increasingly contentious in many local communities (Knopper et al., 2014). This is often because of assertions that sensitive individuals, living in the environs of a wind farm, risk developing an environmental illness (Knopper and Ollson, 2011). This environmental illness, often referred to as wind turbine syndrome, is said to be characterised by the experience of recurrent non-specific symptoms triggered by exposure to the low frequency sub-audible sound (infrasound) generated by wind turbines (Pierpont, 2009). That

some individuals report a sensitivity to infrasound has public health implications given associations between perceived environmental sensitivities and poorer subjective health (Baliatsas et al., 2014); increased health care utilisation (Rubin et al., 2008); decreased occupational performance (Peachey-Hill and Law, 2000); reduced quality of life (Nordin et al., 2013); psychological distress (Skovbjerg et al., 2012); and social withdrawal (Boyd et al., 2012).

Treating individuals reporting symptoms attributed to wind turbine generated infrasound exposure is complicated by the fact the evidence does not support a direct pathophysiological relationship between infrasound and the symptoms experienced (Bolin et al., 2011; Ellenbogen et al., 2012; Merlin et al., 2014). Infrasound is consistently present in the external environment created by natural phenomena, such as air turbulence and ocean waves, and machinery, such as traffic and air-conditioning units (Leventhall, 2006). Further, comprehensive assessment of levels of infrasound at residences close to wind farms has shown

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equivalence with measured levels found in other rural and urban environments and, importantly, that wind turbine generated infrasound does not significantly contribute to background levels of environmental infrasound (Evans et al., 2013).

Understanding what might be causing symptom reports is critical to inform successful interventions to alleviate distress and symptom reporting in communities in which wind farms are proposed and operating. It is noteworthy that experiencing symptoms is a common phenomenon, and is not in and of itself indicative of illness. A recent general population study found that over the course of a week respondents experienced a median number of 5 symptoms, 23% of the population reported 10 or more symptoms, and only 10.6% of respondents were completely symptom free (Petrie et al., 2014). In the case of wind turbine syndrome the collection of symptoms reported, such as headache, tinnitus, fatigue, dizziness, sleep problems, anxiety, irritability, depressed mood, and an inability to concentrate, are commonly experienced in the community (e.g. McAteer et al., 2011; Shargorodsky et al., 2010).

Interestingly, symptomatic experiences attributed to wind turbines substantially occurred after a self-published book (Pierpont, 2009) put forward the theory that wind turbine generated infrasound was causing a constellation of common symptoms in people living close to wind farms, and also outlined a proposed biological mechanism for symptoms (Chapman et al., 2013). Although the established science does not support such assertions, claims that wind farm infrasound is hazardous to health have since proliferated through social discourse and the media, particularly via the internet (Leventhall, 2013). The dissemination of information which creates a perception that an environmental exposure is hazardous to health can itself trigger symptom reporting, even when the environmental exposure is completely innocuous, though the nocebo effect (Crichton et al., 2014a; Faasse and Petrie, 2013). The nocebo effect may be conceptualised as the flip side of the placebo effect and, in a medical context, occurs when side effects are reported follow the administration of an inert medication or procedure (Barsky et al., 2002). The nocebo response to a benign environmental exposure occurs when individuals expect symptoms from exposure so they are more likely to notice and report symptoms consistent with health concerns (Pennebaker, 1994; Petrie et al., 2005). Epidemiological and experimental evidence indicates that, rather than any adverse physiological impact of infrasound, negative expectations and symptom misattribution are driving symptom reporting in the vicinity of wind farms (Chapman et al., 2013; Crichton et al., 2014b).

Given mounting evidence that anxiety and negative expectations may help explain symptom reports attributed to infrasound generated by wind farms, a simple intervention to reverse such symptom reporting might be to provide an explanation of the nocebo effect to those reporting symptoms, to reduce anxiety and change expectations. Evidence suggests that simply telling affected individuals that symptoms do not have an organic basis, and that wind turbine produced infrasound exposure would not cause symptoms, is unlikely to be sufficient to reduce anxiety and symptom reports (Petrie and Sherriff, 2014). However, the provision of a more coherent alternative explanation for the experience of symptoms, such as an account of how nocebo responding could explain symptom reporting, might reduce concern, provide reassurance, and alleviate symptoms.

Accordingly, in this study, we tested the potential for the provision of a nocebo explanation for symptomatic experiences to reverse symptom reporting triggered by negative expectations created from media information about a purported environmental health threat. A community sample was chosen to participate in the study because affected individuals most often identify as a previously healthy member of the community, who now have an

environmental illness having experienced a rapid, intense and/or persistent onset of symptoms which coincided with exposure to wind turbine sound (Chapman, 2011). The study builds on a sham controlled experiment which demonstrated that negative information disseminated by the media about the purported health risks posed by infrasound produced by wind farms creates negative expectations triggering symptomatic responses during exposure to both genuine and sham infrasound (Crichton et al., 2014c). This experiment also revealed that individuals not given negative expectations about the health effects of infrasound, experienced no increase in symptoms during infrasound exposure, further confirming the involvement of nocebo responding in creating symptomatic experiences.

In this study we hypothesised that participants viewing media information about the health risk posed by infrasound generated by wind turbines would exhibit a nocebo response, reflected in increased symptoms and mood deterioration, during simultaneous exposure to audible and sub-audible wind farm sound. We further hypothesised that participants provided information explaining the nocebo effect, following their initial exposure to infrasound, would experience a return to baseline in reported symptoms and mood during a second exposure period. In contrast, we hypothesised that participants provided information about a proposed biological mechanism for symptoms, would maintain elevations in symptoms and deterioration in mood during a second exposure period.

## 2. Materials and method

### 2.1. Study design

This single blind study incorporated a within and between subjects design in which participants took part in two fourteen minute listening sessions, throughout which they were concurrently exposed to infrasound (9 Hz, 50.4 dB) and audible wind turbine sound (43 dB), while reporting on their current symptoms and mood. Participants were randomly assigned to either a nocebo explanation group or biological explanation group, according to a computer generated random number sequence.

Immediately preceding the first listening session participants, in both groups, viewed the same audio-visual presentation featuring material from the internet about the purported health risks posed by infrasound produced by wind farm. During a fifteen minute interval between listening session one and listening session two, participants in the nocebo explanation group viewed audio-visual material which explained that the scientific evidence did not support a direct link between symptoms reported and infrasound, and then described how the nocebo effect could provide a pathway for symptom reporting. In contrast, before the second exposure period, participants in the biological explanation group watched audio-visual material which presented pathophysiological theories for symptom reporting.

Experimental procedures were conducted at the acoustic research facility of the University of Auckland, in a listening room built for experiments assessing subjective responses to sound, to the standard set by the International Electrotechnical Commission (IEC268-13). The study was reviewed by and received ethics approval from the University of Auckland Human Participants Ethics Committee: reference number: 010607.

### 2.2. Participants

A community sample consisting of 66 volunteers, 43 female and 23 male, aged between 17 and 70 years ( $M=27.56$ ,  $SD=12.69$ ), completed experimental procedures. Participants were recruited

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