The social side of noise annoyance (De sociale kant van geluidhinder)

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CHAPTER 1 **Introduction**

1.1 THE SOCIAL SIDE OF NOISE ANNOYANCE

Being exposed to man-made sound is a social[1] experience. This statement implies that when you expose me to sound, the way I think, feel or behave in response to that sound will be influenced by your actual presence, or my imagination of it (Allport, 1985). You expose Me, We expose Them, etc. (Stallen, 1999; Van Gunsteren, 1999). If the above is true, then annoyance problems that arise due to exposure to unwanted man-made sound are a social issue, too. Social scientific research on noise annoyance commonly addresses noise annoyance not as a truly *social* problem. If indeed exposure to man-made sound is a social experience, then consideration of the social side of exposure to man-made sound is valuable. It creates possibilities to draw from the extensive social psychological literature, which can further the theoretical understanding of noise annoyance. It may also inspire innovative ways of annoyance abatement or prevention.

1.1.1 The aims of this thesis

With the research reported in this thesis, I aim to test the 'social hypothesis of noise annoyance': Annoyance with man-made sound is the response to a social experience. I will do this by means of experiments in which I expose participants to noise, and systematically vary the social process between the 'exposer' (the person operating the sound source, i.e., the experimenter) and the 'exposee' (the sound-exposed participant), and assess the arising noise annoyance. For the design of the experiments, I use a social psychological model of noise annoyance (Stallen, 1999) in combination with social psychological theories on procedural justice (e.g., Lind and Tyler, 1988). Procedural fairness is a dimension of the social process in an exchange relationship, which is known to influence the evaluation of received outcomes (e.g., Lind and Tyler, 1988; Greenberg, 1993; Thibaut and Walker, 1975). With these experiments, I test the central hypothesis that the procedural fairness of the social process between the person(s) operating the sound source and the person(s) being exposed to the sound influences the latter's evaluation of the sound.

In this introductory chapter, after a brief description of the scope and consequences of environmental noise, the relative absence of a social perspective in noise research is illustrated by a summary of relevant scientific knowledge with regard to noise annoyance. It is indicated why this absence is considered a problem. The introduction continues with descriptions of a social psychological model of noise annoyance, which does address the social side of the issue (Stallen, 1999), and some social psychological theory on procedural fairness (e.g., Lind and Tyler, 1988; Greenberg, 1993; Thibaut and Walker, 1975). The introduction concludes with a short outline of the contents of the remaining chapters of this thesis.

1.1.2 Noise: its scope and consequences

Noise, commonly defined as unwanted sound, is an environmental problem, and it has been since time immemorial. The myths of the Sumerians (3500-1750 B.C.), written on baked clay tablets found in contemporary Iraq, mention how the god Enlil is angered by the noise made by the people of an overpopulated city. As a solution for his noise problem, Enlil sends a big flood that sweeps over the city (Webster, n.d.). Several thousands of years later, Roman rulers make an effort to reduce noise annoyance when they pass a law that prohibits chariot driving at night through the cobblestone streets (World Health Organization (WHO), 2001). City life in medieval Europe is just as noisy: "Since the guilds insisted that work be done in the open, noise from industrial operations, including the death throes of animals being slaughtered and their cries while driving alive through the cities to the meat hall, were ever-present. Bells tolled the hours. Peddlers hawked their wares, and shopkeepers announced their goods" (Nicholas, 2003, p.160). The town crier wanders the streets spreading information, and official proclamations are read from the balustrades of the town hall. In addition, public processions and itinerant musicians, particularly fiddlers and pipers, perambulate the streets, exposing many inhabitants to the sound they make. In the days of Queen Elisabeth I (1533-1603) noise is certainly not the least of the societal problems: officials make an effort to restore some quiet

[1] In social psychology, *social* refers to 'the way in which people's thoughts, feelings, and behaviors are influenced by the real or imagined presence of other people' (Allport, 1985, quoted in Aronson, Wilson, and Akert, 2002, p.6).

by prohibiting men to beat their wives after ten o'clock at night, because the victims' screaming may keep the neighbors awake (Myncke and Cops, 1985).

Today, still, unwanted sound is a problem. In Europe alone, it is estimated that well over 120 million people are extremely annoyed by noise (European Communities, 2002). The main source of noise pollution is transportation (road, air, and rail traffic). Other important sources are industry, construction activities, and residential activities (WHO, 1999). The World Health Organization mentions a variety of effects on health and well-being associated with noise [2]: interference with communication, noise-induced hearing loss, annoyance responses, as well as detrimental effects on sleep, reading acquisition, social behavior, performance, productivity, and on the cardiovascular and psychophysiological systems (WHO, 1999, 2001; see also Cohen and Spacapan, 1984; Hygge, Evans, and Bullinger, 2002). The costs of general noise to society are estimated to amount to 120 billion Euros a year for the European Union (EU) (European Commission, 1996). The social costs of aircraft noise in the EU can be estimated to amount to 6.8 billion Euros a year[3] (Faburel and Luchini, 2000).

A lot is being done to abate environmental noise problems. Less noisy engines are developed, the operations of noisy artifacts are controlled or restricted (e.g., flight operations, speed limits), environmental planning takes noisy land-use into account; sound absorbing road coating and sound barriers are installed; houses are sound-insulated (e.g., Jue, Shumaker, Evans, 1984). Recently, experiments with agricultural methods and anti-noise are carried out (Murphy, 2002, March 28; TNO, 2006).

Despite all these efforts, a global reduction of noise exposure levels cannot be expected in the near future due to the increasing welfare and mobilization of growing numbers of people (WHO, 2001). In The Netherlands, within ten years, noise may likely be the number one "burden of disease" [4] (in comparison with other environmental stressors) when measured in Disability-Adjusted Life Years (Nederlandse Stichting Geluidhinder, NSG, 2007).

Noise annoyance, one of the negative effects of noise, receives a lot of attention from scientists, policy makers, and the general public. For good reason: annoyance is one of the most common negative effects of noise, and it has been suggested to be an indicator of other adverse noise effects, although no empirical evidence or theoretical underpinning for the latter suggestion is provided (Miedema, 2007). In The Netherlands, noise annoyance has political meaning too, since policy targets with regard to the improvement or preservation of the acoustical quality of residential areas are commonly defined in terms of the prevalence of noise annoyance. Given the actual and future importance of noise and its negative effects on health and well-being, knowledge on noise and its negative effects is of importance to preserve or improve people's quality of life.

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[2] It is subject to discussion whether the link between noise and health effects is causal (Lercher, 1996).

[3] Faburel and Luchini (2000) have tried to relate the nuisance of aircraft noise annoyance to an economic value, using the contingent valuation method. For the area around Paris-Orly airport (population of 62,350 people), where more than half of the people are annoyed by aircraft sound, they calculate that the yearly social costs (measured as the 'willingness to pay in order to suppress the sound annoyance') are about 12 million French francs. This sum equals to 2 million Euros a year. If it is assumed that in this area a number of 35,000 people are annoyed, the willingness to pay per annoyed person can be estimated to 57 Euro per year. For a number of 120 million annoyed people in Europe, the social costs would be 120 million times 57 Euro, which equals 6.8 billion Euros a year.

[4] The notion "burden of disease" and the metric Disability-Adjusted Life Years (DALY) are new means to assess the importance of public health problems that seriously impact well-being but do not (commonly) result in mortality. A short explanation taken from a medical research paper (McKenna, Michaud, Murray, & Marks, 2005, p. 415):
"Mortality data are the most widely used source of information for identifying most important health problems for a population. However, during the 20th century, death rates in economically developed countries have fallen substantially. Correspondingly, many persons live many years with serious illness and disability. Therefore, causes of deaths are increasingly viewed as inadequate measures of the health of a population. Assessments that include more than mortality data to measure population health are frequently called "burden" of disease and injury studies. Such analyses frequently include incidence, prevalence, years of life lost due to premature death, the direct monetary costs of medical care, and the indirect costs related to lost wages and productivity.
A growing body of literature describes the use of summary measures of population health. These reflect both the length of life lost to premature death as well as the time spent in unhealthy states. One such metric, called the disability-adjusted life year (DALY), was introduced by the World Bank in 1993. Subsequently, the World Health Organization (WHO) and Harvard University published a more detailed assessment that used the DALY to enumerate the burden associated with >100 different diseases and injuries. This work, entitled Global Burden of Disease (GBD) primarily assessed burden at the regional, rather than country-specific, level. WHO continues to publish regular updates on the GBD as a statistical annex to the World Health Report."

1.1.3 Brief overview of noise annoyance research

To illustrate the relative absence of a social perspective in noise annoyance research, a brief overview of the preceding research, as far as relevant for the research described in this thesis, is now given.

In the preceding noise research, a large variety of definitions of noise annoyance have been applied in ample scientific studies on noise annoyance. Noise annoyance has been regarded as an emotion, as a result of disturbance, as an attitude, as knowledge, as a result of rational decisions, and as psychological stress (e.g., Guski, Felscher-Suhr and Schuemer, 1999; Stallen, 1999). The World Health Organization (WHO) defines annoyance as "a feeling of discomfort which is related to adverse influencing of an individual or a group by any substances or circumstances" (WHO, 2004, p.3). In this thesis, noise annoyance is defined as "a feeling of discomfort which is related to adverse influencing of an individual by unwanted sound and its circumstances". The WHO-definition of annoyance is followed but for two aspects: firstly, the definition in this thesis is limited to the feeling of an individual (to the exclusion of 'a group') because in the reported experiments the annoyance of individuals has been assessed. Secondly, the sound and its circumstances are expected to be perceived in indissoluble association and are therefore referred to as such ('substances or circumstances' has been replaced by 'sound and its circumstances').

Noise annoyance due to transportation (i.e., road, rail, and aircraft) has been subject to scientific study over the last 60 years (Fields, 2001). The bulk of these studies are large field surveys that investigate the annoying effect of different types of transportation noise on residents in the area surrounding the noise source. Commonly, sound pressure levels are either measured or calculated, and self-reported noise annoyance is assessed with a questionnaire. Generally, noise annoyance levels rise when sound pressure levels increase. Most noise annoyance studies are merely descriptive, although a minority of has aimed at the development of a conceptual model of noise annoyance (for studies aiming at the development of a conceptual model of noise annoyance, see Glass and Singer, 1972; Fidell, Schultz, and Green, 1988; Fields, 1990; Green and Fidell, 1991; Staats and De Jong, 1993; Lercher, 1996; Stallen, 1999; Guski, 1999; Job and Hatfield, 2001).

Dosage-response curves, synthesized from the aggregated data of large numbers of these survey studies, describe this relationship between dose and annoying effect (e.g., Schultz, 1978; Miedema & Vos, 1998). Dosage-response curves are commonly used in applied settings (e.g., decision making in urban planning) to predict the prevalence of annoyance in an area for a given sound pressure level (sound pressure levels are often not measured, but calculated, e.g., based on information on flight patterns) (Fidell, Barber, and Schultz, 1991).

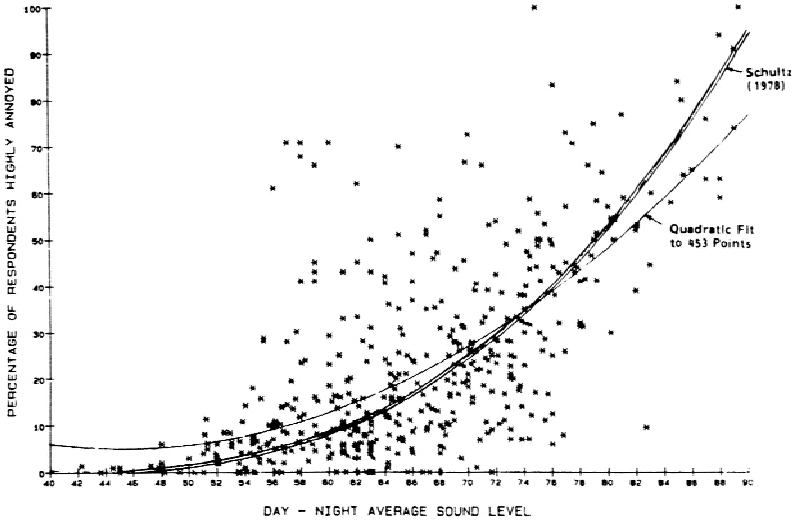

FIGURE 1.1: The third-order polynomial fitting function (Schultz, 1978), and the quadratic fit function (Fidell, Barber and Schultz, 1991) superimposed over 453 data points (reprinted with permission from Fidell, S., Barber, D. S., and Schultz, T. J. Journal of the Acoustical Society of America, Vol. 89, Issue 1, Page 230, 1991. Copyright 1991, Acoustical Society of America). Both dosage-response curves describe the percentage of highly annoyed respondents as a function of the day-night average sound level of transportation noise. However, in particular for sound levels between 54 dB and 80 dB, the difference between predicted and observed annoyance scores is often quite substantial.

The predictive power of the dosage-response curves is typically rather low. The variance in observed annoyance scores is considerable high, as can be seen in Figure 1.1. “Even with the full range of exposure covered and very accurate noise and reaction measurements, noise exposure may only account for 25% – 40% of the variation in reaction” (Job, 1988, p. 996; see also Guski, 1999). Therefore, actual noise annoyance levels frequently turn out to have been over- or underestimated. With regard to using dosage-response relationships for noise policy purposes, Fidell (2003, p. 3011) remarks: “In hindsight, the purely descriptive and exclusively acoustic approach to the problem of predicting community reaction to noise (…) has not been as much of a panacea as once hoped, because the resulting relationships fail to take into account or explain the great variability of community reaction”.

Several attempts to improve the curves’ predictive power have been made: e.g., using other sound metrics or indices (e.g., Fields, 1984; Schultz, 1982; Miedema, Vos and De Jong, 2000), using other mathematical models describing the dosage-response relationship (e.g., Hall, Taylor, and Birnie, 1985; Fidell, Schultz, and Green, 1988; Fidell, Barber, and Schultz, 1991), building source-specific curves (Fields and Walker, 1982; Hall, Birnie, Taylor, and Palmer, 1981; Miedema and Vos, 1998), correcting for ambient noise effects (Fields, 1998), and improving the accuracy of the measurement of annoyance (e.g., Job, Hatfield, Carter, Peploe, Taylor, and Morrell, 2001; Fields, De Jong, Gjestland, Flindell, Job, Kurra, et al., 2001; Berglund, Berglund, and Lindvall, 1976; Botteldooren, Verkeyn, Cornelis, and De Cock, 2001). These alterations have improved the predictive power of the curve to some extent. The approach to noise annoyance research remains ‘purely descriptive and exclusively acoustic’.

Already in the early days of research on the effects of aircraft noise, nonacoustical variables influencing aircraft noise annoyance have been known and studied. For example, the influential Tracor-study identified seven nonacoustical variables that are strongly correlated with noise annoyance: (1) fear of aircraft crashing in the neighborhood, (2) susceptibility to noise (‘noise sensitivity’), (3) distance from the airport, (4) noise adaptability (‘perceived control’), (5) city of residence, (6) belief in misfeasance on the part of those able to do something about the noise problem, and (7) extent to which the airport and air transportation are seen as important (Tracor, 1971, p. 49-53). The sound pressure level (SPL) explained only 14% of variance in noise annoyance scores. The amount of variance in annoyance scores explained by the mathematical model describing the relationship between sound metrics and noise annoyance is boosted to 61% when the above mentioned nonacoustical variables are included (Tracor, 1971, p. 81).

Since the study by Tracor (1971), more has been learned about the nature and scope of nonacoustical correlates of noise annoyance. Many studies have shown a correlation between noise annoyance and nonacoustical variables, like perceived control, noise sensitivity and attitudinal variables (e.g., Fields, 1993; Job, 1988; Goodman and Clary, 1976; Vanderhei Moran, Gunn, and Loeb, 1981; Miedema and Vos, 1999; Guski, 1999, Pedersen and Persson Waye, 2004). In addition, noise annoyance has been found to correlate with situational variables like changes in the sound exposure (e.g., Guski, 1999; Fidell, Silvati, and Haboly; Brown, 1987; Brown, Hall and Kyle-Little, 1985), and exposure context (Weiler, Mortimer, and Stuebing, 1981). Whether nonacoustical variables operate as mediators, moderators, or even as causes of annoyance is unclear (Job, 1988; Guski, 1999; Alexandre, 1976).

The influence of nonacoustical variables on annoyance with transportation noise is quite substantial. Based on a meta-analysis of several survey studies, it has been estimated that the effects of acoustical (e.g., the loudness, pitch, predictability) and nonacoustical variables (e.g., perceived control, personality traits like noise sensitivity, and attitudes towards the sound and its source) each account for about one third of the variance in annoyance scores (e.g., Job, 1988; Fields, 1993; Guski, 1999). The final 33% of the variance is considered error variance.

Perceived control as a cognitive nonacoustical variable influencing noise effects has first been studied about 35 years ago (e.g., Glass and Singer, 1972; Sherrod, Hage, Halpern, and Moore, 1977; Lefcourt, 1973). In (laboratory) experiments, people’s adaptability to noise was investigated. It has been found that the more control a person perceives to have over the noise (or any other stressor), the smaller the negative impact of that stressor (Hatfield, Job, Hede, Carter, Peploe, Taylor, and Morrell, 2002; Jue, Shumaker, and Evans, 1984). Believing that an event is controllable may, however, not always have a positive effect (Folkman, 1984; see also Van den Bos, Bruins, Wilke, and Dronkert, 1999). Personality factors (e.g., internal or external locus of control; ‘learned helplessness’) and situational factors (i.e., whether a person has access to the control switch of the noise source) have

been found to determine how much control a person perceives to have (Glass and Singer, 1972). Specifically the situational factors influencing perceived control have a social touch to them. Nevertheless, they have, to the best of my believe, not been explicitly identified or studied as such.

Noise sensitivity and other personality traits influencing noise annoyance have mainly been studied in an epidemiological context, aiming at the identification of groups of people who are more vulnerable to the negative effects of noise (e.g., Stansfeld, 1992; McLean and Tarnopolsky, 1977). Susceptibility to noise, or self-reported noise sensitivity has been studied in this respect, and is a powerful predictor of noise annoyance (Van Kamp, Job, Hatfield, Haines, Stellato, Stansfeld, 2004; Öhrström, Björkman, and Rylander, 1988; Smith and Stansfeld, 1986; Broadbent, 1972; Miedema and Vos, 2003). Noise sensitivity is supposedly randomly distributed over the population; it is stable over time and it is not influenced by sound pressure level. Noise sensitive individuals commonly perceive more threat from sound, and experience higher noise annoyance than the general public, but they do not perceive the sound to be louder (Stansfeld, 1992; Ellermeier, Eigenstetter, and Zimmer, 2001). Results indicate that about 25% of the individuals in a population are more sensitive to noise (and other environmental aspects) than others.

Attitudinal variables (e.g., beliefs about misfeasance on the side of those operating the noise source, fear of danger from the noise source; beliefs about the importance of the noise source, annoyance with non-noise impacts of the noise source) correlate strongly with noise annoyance (e.g., Guski, 1999; Fields, 1993; Staples, Cornelius and Gibbs, 1999; Taylor, 1984). It has been suggested that the relationship between some attitudinal variables and noise annoyance is, to some extent, causal (Job, 1988; Schomer, 2005). In most studies, attitudinal variables are regarded as individual difference variables: in isolation of the (social) context in which they are formed. A small number of field experiments have shown that the sound management (e.g., providing people with relevant information) can induce an attitudinal change. This may influence the evaluation of the sound, but the results are not conclusive (e.g., Jonsson and Sörensen, 1967; Cederlöf, Jonsson, and Sörenson, 1967; Sörenson, 1970; Maziul and Vogt, 2002; Haugg and Vogt, 2002). Attitudinal nonacoustical variables like ‘trust’ and ‘perceived misfeasance’ indicate that beliefs annoyed people have about the person(s) responsible for the sound influence their noise annoyance. Some of the laboratory experiments described by Glass and Singer (1972) suggest that social processes, like social comparison, modify sound effects (For a more detailed description of these experiments, see Chapter 3).

Generally, models of noise annoyance do not consider the social side of noise annoyance. The simplest models on which the dose-response curves are (implicitly) based, consider only a (curvi-) linear relationship between sound metrics and the annoyance response: the louder the sound, the more likely it is that the individual will be annoyed by it. Nonacoustic influences are denominated as error variance. In psychological models of noise annoyance, the nonacoustic variables influencing noise annoyance are represented as isolated variables, unrelated to external (that is: extra-personal, situational) variables. In such models, sound is considered as an external stimulus perceived by the individual. The model represents no other external stimuli beside the sound. The evaluation of the perceived sound is studied as if it were an individual process, taking place in a social vacuum. The relationship between the sound pressure level and annoyance is (curvi-) linear. The relationship between the sound and the annoyance response of the organism is moderated or mediated by personal difference variables. Sometimes, specifications to the relationship are made for specific sound types (e.g., Glass and Singer, 1972; Staats and De Jong, 1993; Taylor, 1984; Fidell, Schultz, and Green, 1988; Fields, 1990; Green and Fidell, 1991; Lercher, 1996; Guski, 1999; Job and Hatfield, 2001). A minority of scholars has taken a sociological (Fields, 1990, 2003; Bröer, 2006, 2007), historical (Bijsterveld, 2008), or linguistic (Dubois, 2000; Dubois, Guastavino and Raimbault, 2006) perspective on noise annoyance. Generally, the perspective generally taken in noise annoyance research is psychological rather than social.

FIGURE 1.2: Being exposed to a natural nuisance.

1.1.4. Problem definition

Studying noise annoyance from a psychological perspective is a problem if the annoying sound is man-made. Because being exposed to man-made sound is a social interaction: 'You expose Me' (Stallen, 1999; Van Gunsteren, 1999). Even though the nonacoustic variables in psychological models may represent attitudes about the social process (e.g., perceived misfeasance), the social process itself is not represented, and can therefore not be subject of study. In this way, possibly relevant information is easily overlooked. An investigation of the social side of noise annoyance, using a social psychological model, is important because it can further the theoretical understanding of exposure to man-made sound, and may inspire innovative ways of annoyance abatement or prevention. Supposedly, the idea that exposure to natural or man-made sound are two distinctly different experiences is not commonplace.

The crucial difference between annoyance with natural and man-made nuisances is illustrated in Figures 1.2 and 1.3. Both pictures show a lady in an unfortunate situation: her dress has been ruined by unexpected downpour. Likely, a lady will be more or less annoyed by this piece of bad luck. Figure 1.2 gives an example of exposure to a nuisance of natural cause: the nuisance (i.e., rain) does not result from a person's action. Figure 1.3 gives an example of exposure to a man-made nuisance: the nuisance (i.e., spilled water) is caused by the (lack of) action of another person. In both situations, the extent of the lady's annoyance will depend on qualities of the water (e.g., temperature, amount, cleanness, etc.), and on personal difference variables (e.g., perceived control, personality traits, attitudes). Unlike the situation in Figure 1.2, however, the situation in Figure 1.3 is a social interaction: the ladies thoughts, feelings, and behaviors are influenced by the presence of the man on

the balcony. Not just his presence, but his behavior as well. When a nuisance is man-made, the social process between the exposer[5] and the exposee influences how the exposee evaluates the nuisance.

The quality of this social process depends, among other things, on the behavior of the exposer. If the lady in Figure 1.3 perceives that the water falling on her is coming from a garden hose, she will hold the man holding the hose responsible for her mishap. It will matter to her whether the man apologizes, or is clearly not paying attention, or laughs at her face. Her annoyance will be influenced by these perceptions. In a social situation or interaction, an outcome is evaluated by its value *and* by the social dimensions of the situation (e.g., Lind and Tyler, 1988). This implies that manageable social variables codetermine outcome evaluation.

Although nicely parsimonious, a psychological model of annoyance is too limited to explain annoyance with nuisances that are caused by other people. Interestingly, the sounds people complain about are mainly man-made (sounds from transportation, industry, construction and residential activities). Therefore, to study and explain noise annoyance, a *social* psychological model of annoyance is needed: a model that considers as stimuli both the sound and social dimensions of the exposure situation. Annoyance with man-made sound needs to be considered a *social* problem.

1.2 THE PRESENT RESEARCH

1.2.1 Theory

In the next section, the theoretical underpinning of the research described in this thesis is introduced. The presentation starts with the social psychological model of noise annoyance (Stallen, 1999). This model of noise annoyance applies a social perspective, and is the basis of the experimental design of the studies described in this thesis. Social psychology, in particular the social psychology of fairness (e.g., Tyler and Lind, 1992; Thibaut and Walker, 1975; Folger, 1977) is introduced. In the experiments, the fairness of the social process between exposer and exposee is systematically varied, and induces differences in annoyance.

Social psychological model of noise annoyance

The social psychological model of noise annoyance (Stallen, 1999; see Figure 1.4) considers as external stimuli both the sound ('sounds at source') and a social dimension of the exposure situation ('noise management by source'). The perception of these two stimuli influences an internal evaluation process that can result in noise annoyance. This internal evaluation process includes the appraisal of perceived disturbance and perceived control. Stallen presumes that the sound influences the perception of disturbance. The sound management by the source influences the perception of control over one's sound exposure. The model is rooted in the cognitive theory of stress and coping (Lazarus, 1966). The social psychological model of noise annoyance predicts that changing either the sound pressure level or the noise management can influence the level of noise annoyance.

The social psychologic\al model of annoyance (Stallen, 1999) has advantages over a psychological model. The social psychological model gives a more complete description of the noise exposure situation, as the exposee perceives it. It provides the opportunity to make use of existing social psychological knowledge on the influence of social processes. The 'sound management by the source' provides a manageable, nonacoustical codeterminant of noise annoyance that can be controlled separately from the sound. This allows for theory-based, experimental testing of the presumed relationship between social variables and noise annoyance. If the sound management is a codeterminant of noise annoyance, it may be a means of preventing or reducing elevated annoyance levels. This can have practical value if most people have largely the same wishes or norms with regard to the sound management.

Social psychology of fairness

The application of existing social psychological knowledge is an advantage. Social psychology is the scientific study of social behavior. It studies, amongst other topics, how people are affected by social situations. It aims, like general psychology, to understand and predict human behavior. It focuses on generalizations rather than idiosyncrasies, and formulates theoretical explanations for the phenomena it observes. It describes norms most people have with regard to social situations, and describes how specific characteristics of social situations affect most people. Applying social psychological theories in noise annoyance research can further the development of theoretical

[5] Exposer: the person who exposes others to sound, the operator of the sound source; Exposee: the person who is being exposed to sound by others.

knowledge of noise annoyance, in particular because it addresses manageable aspects of the social process between exposer and exposee. Social psychological knowledge may proof to be a source of helpful information for policy makers and airport officials dealing with the abatement of noise annoyance, as well as annoyed citizens, too.

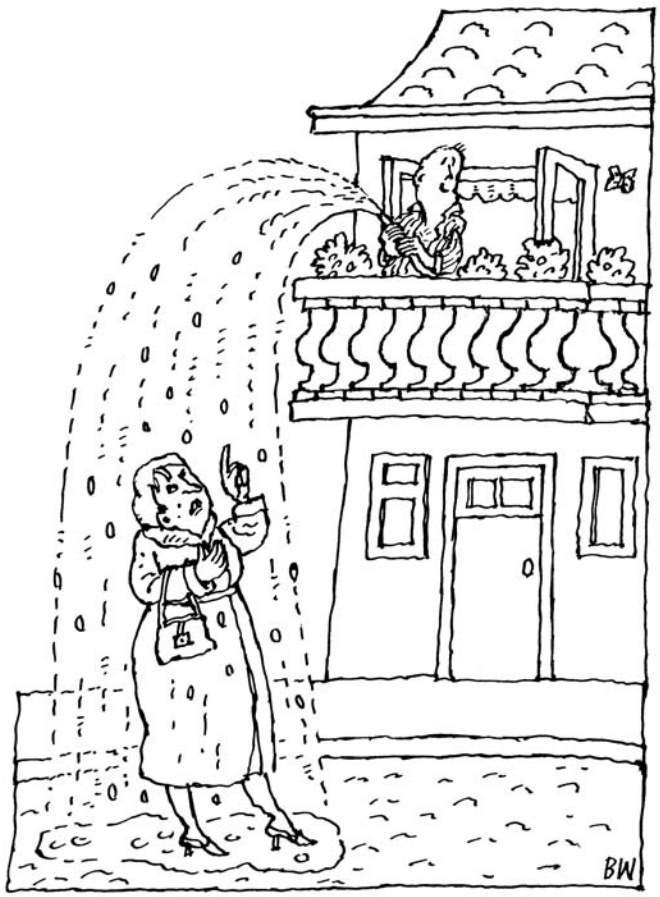

FIGURE 1.3: Being exposed to a man-made nuisance is a social experience.

Social psychological knowledge on fairness (or justice[6]) is of particular interest to noise annoyance research. It is very plausible that people have fairness considerations when judging the distribution of unwanted sound. Generally, people formulate norms in terms of fairness regarding the social dimension of an interaction in which goods are distributed (Adams, 1965, Thibaut & Walker, 1974). They use the fairness (or unfairness) of a distribution as an argument for (or against) that particular distribution. This wish to be treated fairly seems to be deeply rooted. It appears to be an anthropological universal (Montada, 2001), and fairness concerns may even transgress the borders of our species[7] (Brosnan, 2006; Van Wolkenten, Brosnan, De Waal, 2007).

Fairness norms can concern both the actual distribution of the goods (e.g., the fairness of the amount of noise received relative to some standard) (Adams, 1965; Deutsch, 1975; Leventhal, 1976) as well as procedural aspects of the distribution (e.g., the procedure used to decide about a certain distribution, or the behavior of the decision makers) (Thibaut and Walker, 1975; Folger, 1977; Bies and Moag, 1986; Tyler and Lind, 1992; Greenberg, 1993). A number of characteristics of procedures

[6] In this field of theory, the words fair and just are used interchangeably.

[7] Concerns for equity have been observed in nonhuman primates (i.e., chimpanzees and brown capuchin monkeys), ravens, and canids (the family of carnivorous mammals including dogs, wolves, foxes, coyotes and jackals) (Brosnan, 2006; Van Wolkenten, Brosnan, De Waal, 2007)

have repeatedly been found to correlate with evaluations of procedural fairness. Examples of such characteristics are, e.g., opportunities for participation in decision making ('voice'), transparency, consistent application over people and over time, and respectful treatment (e.g., Lind and Tyler, 1988; Mikula, 2001; Greenberg, 1993).

One of the most frequent findings in social psychological justice research is that people, who receive certain goods or outcomes in a social interaction, evaluate these outcomes more positively (or less negatively) when the procedures used to decide about the outcomes are fair. This so-called *fair process effect* has been demonstrated in a wide variety of contexts: e.g., organizations, court trials, police-citizen encounters, and political situations (Folger, 1977; Lind and Tyler, 1988). Fair procedures have been shown to enhance feelings of trust in authorities, and increase people's support for policies (e.g., Mikula, 2001). Unfair treatment has been shown to result in negative affect, protest, contra productive behavior, and illegal actions (Lind and Tyler, 1988). The fair process effect is stronger when the outcomes are negative, or when physical stress is experienced (Tepper, 2001; Vermunt and Steensma, 2001). The effect of procedural fairness on evaluations of man-made sound has, to the knowledge of the author, not been investigated.

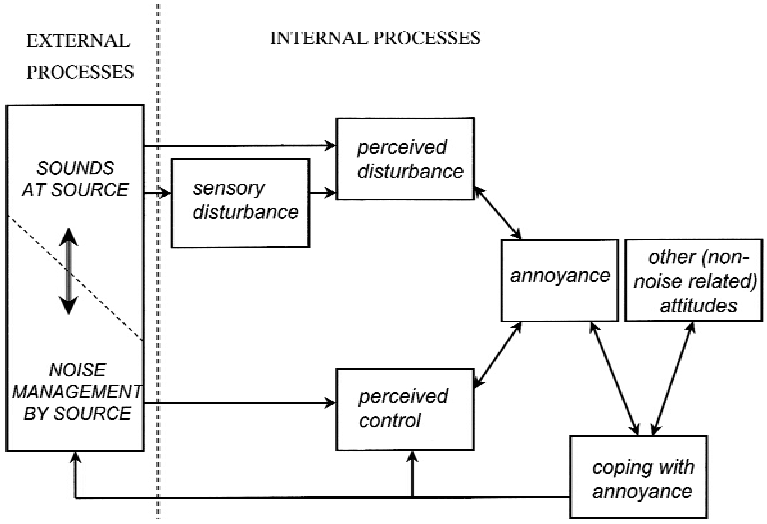

FIGURE 1.4: Social psychological model of noise annoyance. Noise annoyance is a stress response to two external stimuli: 'sound' and 'sound management by the source' (source: Stallen, 1999).

1.2.2 Central hypothesis

This chapter began with the statement that being exposed to man-made sound is a social experience. It follows that noise annoyance is the response to a social experience. The central hypothesis in this thesis is that the procedural fairness of the social process between the person(s) operating the sound source and the person(s) being exposed to the sound influences the latter's evaluation of the sound. It has been derived from the theory described in the previous section. A confirmation of this central hypothesis corroborates the statements made in the beginning.

1.2.3. Method

The central hypothesis is tested in a series of laboratory experiments. Causal relationships are best studied in a theory-based laboratory experiment, in which pre-defined hypotheses can be tested in an environment where random factors influencing the dependent variable (i.e., noise annoyance) can be controlled to an important extent. By analyzing the data with, for instance, Analysis of Variance (ANOVA) conclusions regarding causality can be drawn.

In the experimental design, participants are exposed to a 15-minute sample of aircraft sound while working at a linguistic task. The sound pressure level (SPL) is either low (50 dB A) or high (70 dB A). The procedural fairness of the social process between the 'exposer' (the person operating the sound source, i.e., the experimenter) and the 'exposee' (the sound-exposed participant) is systematically varied. The experimenter manages their exposure to the sound. A neutral, a fair, and an unfair sound management procedure have been designed. Self-reported noise annoyance is assessed with a questionnaire after 15 minutes of sound exposure. In the pilot study, annoyance is assessed also after one minute of exposure. For the design of the experiments, I have used the social psychological

model of noise annoyance (Stallen, 1999), in combination with social psychological theories on procedural justice (e.g., Lind and Tyler, 1988; Greenberg, 1993; Thibaut and Walker, 1975) (For theoretical details, see the theory section in this chapter).

1.3 OUTLINE OF THIS THESIS

Chapter 1, this introduction, describes the central hypothesis and aim of this thesis. For the purpose of illustration, it begins with a bit of history on annoyance with environmental sounds. Next, arguments are presented why, for the study of annoyance with man-made (as opposed to natural) sounds, a social perspective is better suited than a psychological perspective. The general scientific background of the studies is outlined.

Chapter 2 is a report on the pilot of the experimental design. The pilot indicates that the design is promising, and provides suggestions for its improvement. The chapter is written in the style of a journal article, to facilitate comparison of its contents with the contents of Chapters 3 and 4.

The 'Fair experiment' is a refined replication of the pilot study. It investigates the effect of a fair relative to a neutral sound management procedure on noise annoyance. In this experiment, the fair procedure reduces noise annoyance relative to a neutral procedure when the sound pressure level (SPL) is high (70 dB), but not when SPL is low (50 dB). Chapter 3 presents the integral text of the article describing the Fair experiment, as it has been published in Journal of the Acoustical Society of America. It begins with a lengthy introduction, in which preceding studies addressing the social side of sound, be it mostly inexplicitly, are described in some detail. The paper has been written from the perspective of exploring the potential of social nonacoustical variables as instruments for annoyance reduction.

The effect of unfair sound management on noise annoyance, relative to a neutral procedure, is investigated in the 'Unfair experiment'. In this experiment, the unfair procedure increases noise annoyance relative to a neutral procedure for both sound pressure levels (70 dB, as well as 50 dB). Chapter 4 presents the integral text of the article describing the Unfair experiment, as it has been published in Journal of the Acoustical Society of America. The paper has been written from the perspective on finding an explanation for systematic (group-level) deflections from dosage-response curves of noise annoyance. In its introduction, some background information on the dosage-response curve is presented.

The findings of these two experiments, and to a lesser extent the pilot study, are considered in combination in Chapter 5. Conclusions with regard to the central hypothesis and aim of this thesis are drawn. Additional results are described and discussed. Consequences of the findings for a model of noise annoyance, for theory and practice are discussed.

This thesis can be of interest to scientists, policy makers in urban planning, officials from airports and other noise-producing enterprises, and possibly citizens, with an interest in the abatement or prevention of annoyance with man-made noise. The research presented in this thesis shows that taking a *social* perspective on annoyance with a man-made sound makes it possible to profit from existing social psychological knowledge, in particular knowledge about procedural fairness. The findings are likely applicable to annoyance with other types of man-made environmental nuisances.