The social side of noise annoyance (De sociale kant van geluidhinder)
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CHAPTER 4 **The Unfair Experiment**

Annoyance increase through procedural unfairness

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ABSTRACT

General dosage-response curves typically over- or underestimate the actual prevalence of noise annoyance for specific groups of individuals. The present study applies a social psychological approach to noise annoyance that helps to understand and predict collective deflections from the curve. The approach holds that being exposed to man-made sound is more than mere exposure; it is a social experience, too: You expose Me. In effect, social aspects of the situation, like the evaluation of the sound management procedure, influence the evaluation of sound. The laboratory experiment (*N*=90) investigates the effect of procedural unfairness on noise annoyance. The sound management procedure is varied systematically: Participants are promised they will listen to the sound of their choice (i.e., bird song, radio sound, or aircraft sound) but receive aircraft sound despite their expressed preference (unfair procedure), or they are simply told they will listen to aircraft sound (neutral procedure). All are exposed to aircraft sound (50 or 70 dBA Leq). A collective rise in noise annoyance is predicted in the unfair relative to the neutral procedure conditions. Results show that noise annoyance ratings are significantly higher in the unfair relative to the neutral conditions. Consequences for theory and practice are discussed.

4.1 INTRODUCTION

In the field of noise annoyance, it is not uncommon to find that descriptive dosage-response curves over- or underestimate actual noise annoyance levels. Nevertheless, governmental decisions on the location of airports and highway infrastructures, as well as on the award of large amounts of money to mitigate their noise impacts, rest on such dosageresponse curves. On average, annoyance with aircraft sound is underestimated by general transportation noise curves by over 5 dB (Green and Fidell, 1991, p. 241). A thorough reexamination of the often-used FICON-curve indicates a systematic underestimation of annoyance with aircraft sound, particularly for the range of sound exposure levels that are of practical value (Fidell, 2003).

In the literature, several explanations for the systematic underestimation of noise annoyance (“excess annoyance”) have been given. With regard to the technical aspects of the Schultz curve “the functional form of the relationship, the range of values over which the relationship was developed, and its lack of source-specificity” have been blamed (Fidell, 2003, p. 3010; see also Miedema and Vos, 1998). Attempts to solve the problem have been made by fitting different, or source specific, functions on the data, but still much variance remains unexplained (Fidell *et al.*, 1991; Miedema and Vos, 1998).

In addition to these technical curve-related explanations, psychological explanations have been given. Noise annoyance is related to a range of variables besides the purely acoustical parameters. Analysis of survey data shows that much variance in annoyance scores is attributable to nonacoustic variables [e.g., noise sensitivity, and attitudinal variables like perceived mal- or misfeasance, distrust in authorities, uncertainty regarding the (future) noise environment (e.g., Sörenson, 1970; Staples, 1996; Guski, 1999; Fields, 1993; Job, 1988)]. Considered from a psychological perspective, noise annoyance is not a function of solely the characteristics of the acoustic stimulus, it is a function of a dynamic cognitive process in which the acoustic stimulus *and* a diversity of nonacoustic variables, including the attribution of semantic features, play a role [for an illustration of the cardinal role played by cognition in the evaluation of complex sounds, see Dubois *et al.* (2006); for an experiment illustrating semantic influences on sound evaluations, see Guastavino (2007)]. 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”) but the influence of circumstances is not incorporated in the dosageresponse curves.

The causal direction of the relationship between nonacoustic variables and noise annoyance is not clear. It is plausible (Job, 1988; Cederlöf *et al.*, 1967) that variations in certain nonacoustic variables have a causal relationship with variations in noise annoyance. Although nonacoustic variables are likely related to stable person-related factors like personality or genetic make-up, it has been argued that they may to a certain extent be influenced by situational factors. For instance, during situations of change, the heightened publicity and media attention may make residents more aware of the (effects of) noise than would be expected in a steady-state situation. Also, resentment with regard to perceived unfairness of the decision-making process (Fields *et al.*, 2000) has been speculated to increase the likelihood of residents' reporting annoyance (e.g., Green and Fidell, 1991). For the prediction of noise annoyance levels it is interesting to know whether a person's sensitivity or attitude toward sound can be influenced by situational variables.

If the majority of people in a community respond in largely the same way to the situational factors that affect noise annoyance, this will cause collective deflections from the dosage-response curve, rather than random variance in individual annoyance scores. There are indications that indeed deflections from the dosage response curve are to some extent collective. Research has shown that descriptive models of noise annoyance explain more variance in annoyance scores when they are enriched with one free parameter to account for collective nonacoustic differences: Up to an additional 47% of variance in annoyance scores is accounted for when a nonacoustic parameter, correcting for data-setspecific elevations or depressions in noise annoyance that cannot be explained by acoustical variables, is included in the mathematical model (Green and Fidell, 1991, p. 237; Fidell *et al.*, 1988; Miedema and Vos, 1999).

Notwithstanding the noteworthy improvement in the power of such enriched models, these models are purely descriptive and therefore neither improve the prediction of deflections from the curve, nor further our theoretical understanding of the psychology of annoyance in general, and the influence of nonacoustic factors in particular (Fidell, 2003). This is unfortunate, as both are needed to improve the abatement and prevention of noise problems (Staples, 1997, 1996). Given the financial and political costs of inaccurate predictions of annoyance and the apparent bother experienced by residents, it is important to further the theoretical understanding of noise annoyance in order to improve the accuracy of its prediction.

In this paper, it is argued that collective deflections from the curve can be understood and predicted when the social nature of noise annoyance is taken into account. Man-made environmental sound is rarely perceived in a social vacuum. People associate a sound they hear with its source (Guastavino, 2006), and in the case of man-made sound they may hold the operators of the source responsible for their exposure. Being exposed to man-made sound is a social experience: You expose Me (Stallen, 1999). The social process that characterizes a social experience influences the evaluation of that social experience as well as its associated outcomes (e.g., Lind and Tyler, 1988). When "You expose Me" to sound I do not like to hear, my judgment of the social process between us likely influences how far I will be annoyed by the fact that you are exposing me, and in how far I will be annoyed by the sound you make (Stallen, 1999; Van Gunsteren, 1999). Hence, the social process can be a situational factor that influences the cognitive process of sound evaluation. This is interesting, because the quality of the social process is, to a certain extent, tractable to the people who are causing the noise. For example, if a person planning a late-night party at their home checks with their neighbors whether the timing of the party matches the neighbors' plans for the weekend, their annoyance with the party noise will likely be lower. Not only the acoustical properties of the sound can be a source of annoyance and discomfort, the social process instigated by the operators of the noise source can be a cause for dissatisfaction, too.

Many dimensions of the social process may be important in determining people's reactions to social experiences and related outcomes. One dimension has dominated social psychological research: The perceived fairness of the social process, in particular the fairness of the procedures used (Lind and Tyler, 1988, p. 1). In social psychology, a procedure is considered fair when people judge it to be fair[17]. Social psychological theories of justice describe an array of procedure characteristics that

[17]In social psychological theories of justice, the concepts fairness and justice are used interchangeably. The semantics of the fairness (or justice) concept are context dependent. Philosophers have studied the concept for centuries, if not millennia, and in a whole range of scientific disciplines (e.g., law, political sciences, anthropology, sociology) research on fairness (or justice) is conducted. "In contrast to other disciplines, social psychology does not take a normative approach [to justice]. It deals with justice in a descriptive rather than a prescriptive way. The aim is not to define what is just and unjust, and how justice can be achieved. The focus on the contrary is on the subjective sense of justice and injustice and its impact on human action and judgment. Social psychologists study what people regard as just and unjust under given circumstances, how people deal with

enhance fairness judgments, identified over years of experimental and survey research. Among other criteria, procedures are generally judged to be fairer when they (1) are transparent; (2) offer opportunities for participation in the decision-making process (e.g., "voice"); (3) are applied consistently across time and across persons; and (4) are applied in a respectful manner (Lind and Tyler, 1988; Mikula, 2001; Greenberg, 1993, for a concise review and meta-analysis of 25 years of social justice research, see Colquitt *et al.*, 2001). Theories of social justice distinguish up to four dimensions of justice (or fairness). Distributive justice (the fairness of outcomes relative to a certain standard, e.g., Adams, 1965; Deutsch, 1975; Leventhal, 1976) is distinguished from procedural justice (the fairness of the processes whereby outcomes are allocated, e.g., Thibaut and Walker, 1975; Folger, 1977; Tyler and Lind, 1992). Interpersonal justice "reflects the degree to which people are treated with politeness, dignity, and respect" (Colquitt *et al.*, 2001, p. 427), and informational justice "focuses on the explanations provided to people that convey information about why procedures were used in a certain way or why outcomes were distributed in a certain fashion" (Colquitt *et al.*, 2001, p. 427; Greenberg, 1993; Bies and Moag, 1986). Research has indicated that the four dimensions of fairness can have interactive effects (Colquitt *et al.*, 2001). In practice, however, these theoretical dimensions may overlap.

Fair procedures have been found to increase outcome satisfaction (the "*fair process effect*") (e.g., Lind and Tyler, 1988), and to decrease psychological stress (Vermunt and Steensma, 2001, 2003, 2005). The fair process effect is stronger when the outcomes are negative, or when physical stress is experienced (Tepper, 2001; Vermunt and Steensma, 2003). Research has also indicated that fair management procedures enhance feelings of trust in authorities, and increase people's support for policies (e.g., Mikula, 2001). Sound management activities by the operators of a sound source can be considered procedures (i.e., the operator allocates the sound to the residents). Hence, it can be expected that the perceived fairness of sound management procedures will influence people's evaluation of the sound. Results from several studies demonstrate the influence of procedures on reactions to noise, but the perceived fairness of these procedures has not been assessed (Glass and Singer, 1972; Cederlöf *et al.*, 1967; Maziul and Vogt, 2002). A theoretical framework has not been proposed that explains or predicts effects of social processes on noise annoyance.

Social psychological theories of justice propose two major explanations why procedural fairness is generally much appreciated and related to higher outcome satisfaction. The *instrumental* explanation holds "that people are concerned about justice because it serves their self-interest of maximizing their outcomes in the long run" (Mikula, 2001, p. 8066, e.g., Thibaut and Walker, 1975). This perspective holds that fair procedures are appreciated because they give more (indirect) control over the process and the related outcomes.

Mediation analysis has shown that perceived control accounts for some but not all of the positive effects of procedural justice (Lind *et al.*, 1990). The *relational* or group value explanation, on the other hand, holds that "people are concerned about their position in groups. They use experiences with their treatment by authorities as a source of information about their social position. The evidence that they are treated justly indicates that they are worthy members of the group" (Mikula, 2001, p. 8066, e.g., Tyler and Lind, 1992). Being treated with an unfair procedure is an indication that one has low status and is given little respect. Hence, unfair procedures and their outcomes are negatively evaluated and may give rise to psychological stress.

The effect of procedural fairness on evaluations of noise has been investigated (Maris *et al.*, 2007a, 2004a, 2004b). In a laboratory experiment, participants are exposed to aircraft sound (50 vs 70 dB A) while they work at a reading task. The preceding sound management procedure is either fair (participants are given "voice" before they are exposed to the sound) or neutral (participants are simply told they will be exposed to the sound). "Within the 70 dB SPL condition, the fair procedure reduces the mean annoyance level to approximately the level in the 50 dB SPL condition. Up to 9% of variance in annoyance scores can be explained by the procedure manipulation" (Maris *et al.*, 2007a). The procedure effect is not found in the 50 dB SPL conditions. The study demonstrates that under laboratory conditions and with rather loud sound, a fair sound management procedure ameliorates noise annoyance. It does not answer the question whether an *unfair* procedure can cause a collective increase in annoyance.

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the concept of justice, how they react to situations that they regard as unjust, and under which circumstances, and why, people care about justice" (Mikula, 2001, pp. 8063–8064). Although it is very likely that substantial cultural differences exist with regard to which procedures people regard as just, the wish to be treated in a just way appears to be an anthropological universal (Montada, 2001).

The present study investigates whether a collective increase of noise annoyance can be due to procedural unfairness. In other words: Can a procedurally unfair interaction with the operators of the sound source cause excess noise annoyance? The present experiment largely replicates the earlier experiment by Maris *et al.* (2007a). Participants go through a noise management procedure before they are to perform a reading task while being exposed to annoying sound (played at 50 or 70 dB A). In the neutral procedure conditions participants are simply told that they will be exposed to aircraft sound. The unfair procedure is nontransparent as well as inconsistent: Participants are promised that they will be exposed to the sound type of their choice (nature, radio, or aircraft sound), which they, on the experimenter's request, have clearly indicated on a form. The experimenter reads the form and gives them aircraft sound without explaining why he or she does not follow the previously described procedure. No word of regret is given. [Giving participants a sincere apology or plausible explanation for the broken promise will give the unfair procedure a fair dimension (Bies and Shapiro, 1988). This is undesirable, as this fairness may exceed, or interact with, the unfairness of the broken promise. Alternatively, ambiguity is avoided because then the fairness of the interaction will lie entirely in the eye of the beholder rather than in the manipulation. Therefore, it is needed that the experimenter interacts in this slightly disrespectful manner.] Sound exposure levels and noise management procedures are varied systematically, and the dependent variables are assessed with a questionnaire. Data from participants who chose aircraft sound is excluded from the analyses.

The model used for the design of the study is a simplified version of the social psychological model of noise annoyance [Stallen, 1999; see Fig. 3.1; for a more detailed description of the experimental model see Maris *et al.* (2007)]. In the model, noise annoyance is represented as an expression of psychological stress, arising when the perceived level of disturbance due to the sound outgrows the perceived level of control over the sound ("internal processes"). People are expected to pay attention to the sound *and* to the sound management procedure; therefore both are included on the stimulus side of the model ("external processes"). The model further holds that the perceived disturbance is a function of the sound, and that the perceived control is a function of the perceived sound management. Whether or not noise annoyance arises depends on the perception and evaluation of the sound in combination with the sound management.

It is expected that acoustical as well as procedural aspects of the noise exposure situation will influence the level of noise annoyance in the experiment. Obviously, it is hypothesized that in the high sound pressure level (SPL) conditions the annoyance levels will be higher than in the low SPL conditions (Hypothesis 1). In addition, it is expected that systematic differences in the sound management procedure will yield systematic and collective differences in noise annoyance. Specifically, it is hypothesized that noise annoyance will be significantly higher in the unfair procedure conditions than in the neutral procedure conditions; that is: Excess annoyance will arise in the unfair procedure conditions (Hypothesis 2). The effects of procedural unfairness can be enhanced by negative outcomes or stress (Van den Bos *et al.*, 1998; Vermunt and Steensma, 2003). In the Maris *et al.* study (2007), a fair process effect was found only when the sound was loud (that is, when the outcome is negative). In the present experiment, it is expected that, to the participants in the unfair procedure conditions, the sound will be a negative outcome whether it is loud or not. Because participants have explicitly requested either nature or radio sound, receiving aircraft sound (of equal loudness) will be considered a negative outcome.

Therefore, an effect of procedural unfairness on noise annoyance is expected in the low SPL conditions *and* in the high SPL conditions (Hypothesis 3). No expectations are formulated regarding the relative strength of the procedure effects in the low and high SPL conditions. It is possible that the sound triggers a stronger procedure effect when it is both unwanted and loud (unfair, high SPL condition) than when it is unwanted but not loud (unfair, low SPL condition). It is also possible that the procedure effect is either triggered or not, and is always of the same strength.

Social psychological theories of justice offer instrumental and relational explanations for an effect of procedural unfairness on evaluations of sound (e.g., Lind *et al.*, 1990). It is explored whether instrumental or relational concerns mediate the procedure effect in the current study. It is hypothesized that if the effect of procedural unfairness on noise annoyance is mediated by instrumental concerns, the perceived control over the sound will mediate the procedure effect on noise annoyance (Hypothesis 4). Alternatively, if relational concerns mediate the procedure effect, the perceived regard of the experimenter to the participant will mediate the procedure effect (Hypothesis 5).

4.2 METHOD

4.2.1 Participants

One hundred and ten students, recruited from all departments of Universiteit Leiden, The Netherlands, are paid 5 Euro each to participate in the experiment, which lasts approximately 50 min. The participants are randomly assigned to each cell of the experimental design. Data from eight cases are excluded because these cases have indicated to have hearing problems. Data from another twelve cases are excluded from the analyses because these cases have chosen aircraft sound (see Sec. 2 D). Data from 90 students [74% female, mean age 21 years (s.d.=2.5)] are analyzed.

4.2.2 Experimental design

The experimental design is a 2 (procedure: neutral versus unfair) x 2 (sound pressure level (SPL): low (50 dB) versus high (70 dB)) complete factorial design.

4.2.3 Laboratory layout and stimulus material

The laboratory consists of four separate cubicles, each of which contains a desk and chair, and a complete PC set with two loudspeakers plus one subwoofer. In each session all participants are exposed to the same sound pressure level and procedure.

The three sound samples used in the introduction are (1) recordings of bird song taken from a CD (nature sound; Korenromp, 2000), (2) recordings of a radio broadcasting show including both music and speech (radio sound), and (3) the sound of an aircraft passage (aircraft sound; an excerpt from the experimental sample). All are played at approximately 60 dB A (1 min Leq).

The experimental sample is composed of self-recorded audio material of aircraft passages of various loudness and duration[18]. The experimental sample is played at either 50 dB A (15 min Leq) (low SPL condition) or 70 dB A (15 min Leq) (high SPL condition), which implies a sound level of quiet background noise in the low condition or of speech interfering loudness in the high condition. The maximal sound pressure level is 68 or 88 dB A Lmax, respectively. All sound pressure levels are measured in the cubicle at the position of the listener's ears.

The reading task (an English text with multiple choice questions, taken from a Dutch exam from pre-university education) is selected to match the cover story (see Sec. 2 D) and because it assures participants' motivation to perform well and closely matches their capacities. With too easy a task the experimental noise may not cause any disturbance and hence not induce annoyance. Too difficult a task may give rise to performance effects and task related frustration, which may cloud the effects of the procedure and/or the SPL manipulation (Smith, 1989).

4.2.4 Experimental procedure and manipulations

Upon their arrival at the laboratory, the experimenter leads the participants to their cubicle. After being seated, participants are left to themselves. Before starting to interact with the computer, participants read and sign an informed consent form, which informs them about their rights, among them the right to terminate their participation in the experiment at any moment. The computer is used for the presentation of the stimulus information and the recording of the dependent variables. (See Fig. 4.1 for a visual representation of the flow of the experiment.)

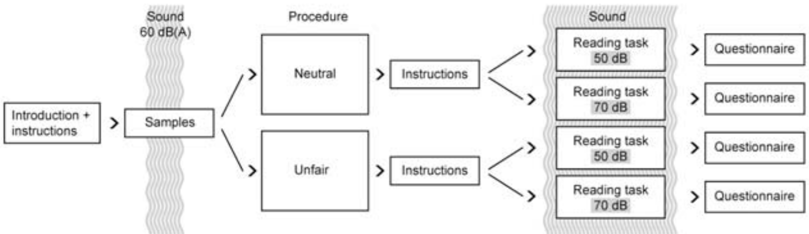

FIGURE 4.1. Visual tree representation of the flow of the experiment.

[18]The audio material is recorded outdoors, with clear weather conditions, on one location in the vicinity of a runway in use for landings only. A professional company has removed ambient sounds from the recordings by a professional company. The 15-min experimental sample is made up of 11 noise events of aircraft passages of various loudness, duration, and aircraft type. The quiet time between two passages (1 min, on average) is shorter than in real life and of variable duration.

As a cover story, participants are told that they are engaged in a study on potential performance effects of disturbing sound during high school exams. As an introduction to the interaction with the computer, a series of three short sound samples dispersed by short questions is presented to the participants. The samples are of birds singing, a radio show, and of an aircraft passage. In fact, this series of samples gives all participants the same frame of reference with regard to the loudness and pleasantness of sounds in the experimental situation, as well as sets the stage for the procedure manipulation.

In the *neutral procedure* conditions, after participants are informed that in the main experiment they will be listen-ing to a 15-min sample of aircraft sound, they are asked to evaluate the three introductory samples before starting the main experiment. "Imagine yourself reading a difficult text hearing one of the three sound types (nature, radio, aircraft) as a background sound. Which sound type would seem the least taxing to you? Please write down your motivated answer." They write down their, often elaborate, answer on a paper "answering form."

The computer interface is designed in such a way that the experiment can only continue after the experimenter has entered a password to select either natural, radio, or aircraft sound. The instructions tell the participant to open the door of their cubicle in order to signal to the experimenter that they are ready to proceed. The experimenter enters the cubicle, collects the paperwork (informed consent, and answering form), enters the password for aircraft sound, and says: "I have set the computer to aircraft sound." The experimenter then leaves the participant to continue with the reading task.

In the *unfair procedure* conditions, participants are informed that in the main experiment they will be listening to a 15-min sample of their choice: nature, radio, or aircraft sound. Their choice is given significance by a remark that earlier research has indicated that participants who have been given the sound of their choice are far less tired after the experiment. Then, they are given the opportunity to indicate their preference: "Imagine yourself reading a difficult text hearing one of the three sound types (nature, radio, aircraft) as a background sound. Which sound type would seem the least taxing to you? Please write down your motivated choice." They write down their, often elaborate, answer on a paper "choice form", on which they also have to clearly visible circle the sample type of their choice.

The computer interface is designed in such a way that the experiment can only continue after the experimenter has entered a password to select either natural, radio, or aircraft sound. The instructions tell the participant to open the door of their cubicle in order to signal to the experimenter that they are ready to proceed. The experimenter enters the cubicle, collects the paperwork (informed consent, and choice form), has a look at the choice form, notices the indicated preference, and says "Oh yeah, your preference, well…" enters the password for aircraft sound, and says "I have set the computer to aircraft sound." The experimenter does not give any explanation for not following the procedure, and leaves the (often protesting) participant to continue with the reading task.

In *all conditions*, participants then start working on the reading task and related questions while being exposed to the aircraft sound sample (played at either 50 or 70 dB A). The reading task and the sound are automatically terminated after 15 min (none of the participants have by then finished the task). The computer then presents the questionnaire, which assesses the dependent variables and the manipulation checks. After the participants have completed the questionnaire, they check with the experimenter who thoroughly debriefs them and pays them.

4.2.5 Measures

Manipulation checks

One question checks the perceived loudness of the experimental sound ("perceived loudness"): "If you were to give a grade for the average loudness of the aircraft sound, what grade would you give?" Participants respond by clicking on one out of ten virtual buttons, shaded from white to black (see Fig. 4.2). The intensity of the greyscale indicates the intensity of the sound, and the first and the last button are labelled verbally (white = "the softest sound I have ever heard," black = "the loudest sound I have ever heard"). The scores are coded into numbers ranging from 1 (white) to 10 (black)[19]. The mean score on this measure [M(s.d.) =6.92 (1.77)] is significantly higher than the

[19]For the perceived loudness measure, a ten-point scale is used (deviant from the annoyance measure, which uses a seven-point scale) to prevent participants from ticking the exact same number on the annoyance measure and the perceived loudness measure, aiming to give a consistent (socially desirable) rather than a faithful answer. In earlier experiments the

scale's midpoint 5.5 [$t(89)=7.63$, $p<0.001$], which indicates that on average participants considered the sound to be loud.

FIGURE 4.2. The greyscale of the manipulation check for perceived loudness of the sound. Participants respond by clicking on one out of ten virtual buttons, shaded from white to black. The intensity of the greyscale indicates the intensity of the sound; the first and the last button are verbally labelled (white = "the softest sound I have ever heard," black= "the loudest sound I have ever heard").

One question checks the perceived procedural fairness ("perceived procedural fairness"): "In my opinion, the procedure used by the researcher to select the sound I got to listen to, is…" Verbal labels are given for the end points of the scale (1= "very unfair" to 7= "very fair."). The mean score on the scale is M(s.d.) = 4.04 (1.56).

Three explorative measures of task performance, to be used as a check for unintended performance effects, are automatically registered by the computer [(Time:" Time in seconds taken to read the first text and answer the first question, M(s.d.)=88.26 (40.04), 5% trimmed mean=86.03; "Correct:" Total number of correct answers, M(s.d.)=10.20 (3.64); "False:" Total number of false answers, M(s.d.) =4.19 (2.86)].

Dependent variables

The questionnaire includes three items that assess the participant's noise annoyance ("noise annoyance") with the experimental sound: (i) "To what extent did the sound annoy you while you were working at the task?," (ii) "How did you experience the aircraft sound while answering the exam questions?," (iii) "How pleasant did you feel the aircraft sound was while working on the exam?" Answers are given on a seven-point numerical rating scale, with verbal labels at the end points: (i) 1="not at all annoying," 7=" highly annoying," (ii) 1= "very positive," 7= "very negative," (iii) 1= "very pleasant," 7= "very unpleasant." A noise annoyance scale is constructed by averaging the scores on the three items (Cronbach's α =0.73). The mean noise annoyance score is 5.65 (s.d.=0.97). The Pearson's correlation between noise annoyance and the manipulation check perceived loudness is r = 0.38 ($p < 0.001$).

Instrumental concerns. One item assesses the participant's perceived control over the experimental sound: "During the task, to what extent did you feel to have (had) control over the sound you were being exposed to?" Answers to this "perceived control" item are given on a seven-point numerical rating scale, with verbal labels at the end points: 1 = "not at all" to 7= "to a great extent." The average score on the perceived control item is *M*=2.56 (s.d.=1.74).

Relational concerns. Two items assess the perceived regard of the experimenter to the participant: (i) "The experimenter made an effort not to tax me unnecessarily with the sound," and (ii) "In your opinion, how respectful have I, the researcher, treated you?" Answers are given on a seven-point numerical rating scale, with verbal labels at the end points: (i) 1= "totally disagree" to 7= "completely agree," and (ii) 1= "very disrespectful," 7= "very respectful." No relational concern scale is constructed because the two items share relatively little variance (r = 0.35; p < 0.001). The two items, (i) effort [*M*(s.d.)=3.87 (1.77)] and (ii) respect [*M*(s.d.)=5.10 (1.53)], are analyzed separately.

Finally, some general questions [e.g. gender, self-reported hearing impairments ("Do you have any hearing impairment?," response categories (i) "yes," (ii) "somewhat," (iii) "no")] are included. Participants who indicate to have (slight) hearing impairments (categories "yes:" *N*=0, and "somewhat:" *N*=8) are identified as having hearing impairments.

4.3 RESULTS

All analyses have been performed with and without the self-reported hearing impaired cases. The reported results are exclusive of the hearing impaired cases. Unless noted otherwise, the results

exact same manipulation of sound pressure levels was applied (Maris et al., 2007, 2004). In these experiments, a numerical scale (ranging from 1 to 10) has been used. This numerical scale has indicated that the SPL manipulation induces very stable and strong differences in perceived loudness. In the current experiment, instead of a numerical scale, a discrete greyscale is used. It is expected that compared to numbers, visual intensity may be a more natural representation of auditory intensity.

are not notably different when the hearing impaired cases are included. By default, all reported significance levels are given for two-tailed tests with an alpha value of α =0.05. A statistical test for homogeneity of error variances is reported for all analyses of variance, because the experimental design is slightly unbalanced (since data from participants who chose aircraft sound is not included in the analyses). When error variances are nonhomogeneous, a more conservative statistic is reported in addition to the common *F*-statistic.

4.3.1 Manipulation checks

Perceived loudness

Analysis of variance (ANOVA) with perceived loudness as the dependent variable and sound pressure level (SPL) and procedure as the independent variables shows a main effect of SPL [$F(1,86)=55.05$, $p < 0.001$, $\eta^2=0.39$]. Levene's test for equality of error variances [$F(3,86)=5.03$, $p < 0.005$] indicates that equal variances between groups cannot be assumed. The more conservative Welch' variance-weighted ANOVA (one-way) indicates that significant differences between groups exist [$F(3,41.94)=20.40$, $p < 0.001$], and a post-hoc contrast test (equal variances not assumed) indicates that the mean loudness scores of the high SPL and low SPL conditions are significantly different [$t(51.96) = -6.92$, $p < 0.001$]. The aircraft sound in the high sound conditions is perceived to be significantly louder [*M*(s.d.)=8.00 (1.17) than in the low sound conditions *M*(s.d.)=5.80 (1.58)], indicating that the SPL manipulation was successful. No other significant effects are found [procedure: $F(1,86)=0.26$, n.s.; SPL * procedure: $F(1,86)=0.05$, n.s.], which indicates that the procedure manipulation did not influence perceived loudness.

Perceived procedural fairness

ANOVA with perceived procedural fairness as the dependent variable and SPL and procedure as the independent variables indicates that the unfair procedure [*M*(s.d.) =3.56 (1.64) is perceived to be significantly less fair than the neutral procedure (*M*(s.d.)=4.71 (1.18); $F(86)=13.41$, $p < 0.001$, $\eta^2 = 0.14$); equal error variances can be assumed: Levene's $F(3,86)$ =1.76, p=0.16, n.s.]. The deviation from the neutral score (4) is significant for the neutral condition [$t(37)=3.70$, $p < 0.01$] and marginally significant for the unfair condition [$t(51) = -1.95$, $p = 0.06$]. Strictly, the unfair procedure is not unfair in an absolute sense, but relative to the neutral condition it is significantly less fair. It is concluded that the procedure manipulation has been successful.

The main effect of SPL on perceived procedural fairness [$F(1.86)=4.06$, $p < 0.05$, $\eta^2 = 0.05$] indicates that the perceived fairness of the procedure is influenced by the sound pressure level. In the high sound condition the procedure is evaluated as more fair [*M*(s.d.)=4.35 (1.70)] than in the low sound condition [*M*(s.d.)=3.73 (1.35)]. No interaction of SPL and procedure on perceived procedural fairness is found [SPL * procedure: $F(1,86)=0.87$, n.s.].

Performance measures

Multivariate analysis of variance with the performance measures time, correct, and false as the dependent variables and SPL and procedure as the independent variables is performed to check for unintended performance effects, and shows no significant multivariate effects [SPL: $F(3,84) = 0.20$, n.s.; procedure: $F(3,84)=0.46$, n.s.; SPL * procedure: $F(3,84)=0.46$, n.s.; equal error variances can be assumed: Box's M=14.24, $F(18, 21118.37)=0.74$, p=0.77, n.s.]. The manipulations have not induced differences in performance.

4.3.2 Dependent variables

ANOVA with noise annoyance as the dependent variable and SPL and procedure as the independent variables is performed to test Hypotheses 1–3. Marginal means and cell means are summarized in Table 4.I. The effects are described in the remainder of this section. Correlations between the dependent and independent variables are given in Table 4.II.

It has been hypothesized that higher sound levels will result in higher noise annoyance levels (Hypothesis 1). The ANOVA shows a significant main effect of SPL on noise annoyance, indicating that participants who have been exposed to high sound are more annoyed than those receiving low sound [$F(1,86)=9.94$, $p < 0.01$, $\eta^2=0.10$; equal error variances can be assumed: Levene's $F(3,86)=1.93$, $p = 0.13$, n.s.; see Table 4.I for marginal means]. This finding confirms Hypothesis 1: The high sound level induces higher noise annoyance levels than the low sound level.

In the ANOVA, the main effect of procedure on noise annoyance [$F(1,86)=5.32$, $p < 0.05$, $\eta^2=0.06$] shows that participants who have been confronted with a broken promise with regard to their noise exposure (unfair procedure), report more noise annoyance [*M*(s.d.)=5.85 (0.91)] than those who have simply been told they will be hearing aircraft sound (neutral procedure) [*M*(s.d.)=5.41 (1.01)]. This finding confirms Hypothesis 2: The unfair procedure yields higher noise annoyance levels than the neutral procedure.

TABLE 4. I. Noise annoyance scores (1= "not annoyed at all," 7= "highly annoyed") arranged by conditions of sound pressure level (SPL: low or high) and procedure (neutral or unfair). Cell means and marginal means (*M*), standard deviations (S.D.), and number of cases per cell (*N*) are given.

SPL	**Procedure**	*M*	*SD*	*N*
Low	Neutral	5.07	1.12	18
50 dB	Unfair	5.55	0.91	26
	Total Low	5.34	1.02	44
High	Neutral	5.72	0.83	20
70 dB	Unfair	6.14	0.83	26
	Total High	5.96	0.85	46
Total	Neutral	5.41	1.01	38
	Unfair	5.85	0.91	52
	Total	5.66	0.97	90

TABLE 4.II. Pearson's correlations and point-biserial correlations between the dependent variables and the independent variables. Procedure and sound pressure level (SPL) are dichotomous variables (procedure: 1=neutral, 2=unfair; SPL: 1=50 dB, 2=70 dB).

N =90	SPL	Noise Annoyance	Perceived Control	Effort	Respect
Procedure	-0.03	0.22 *	-0.09	-0.32 **	-0.52 ***
SPL		0.31 **	-0.06	-0.31 **	0.12
Annoyance			-0.10	-0.25 *	-0.16
P. Control				0.23 *	0.09
Effort					0.35 ***

* correlation is significant at the 0.05 level (2-tailed)
** correlation is significant at the 0.01 level (2-tailed)
*** correlation is significant at the 0.001 level (2-tailed)

No interaction effect of procedure by SPL on noise annoyance is found [$F(1,86)=0.02$, $p = 0.89$, n.s.]. The effect of procedure on noise annoyance is found for the participants who have been exposed to 50 dB as well as for those who have been exposed to 70 dB, which confirms Hypothesis 3. The absence of an interaction effect also indicates that the procedure effect has the same strength in both SPL conditions. The effects of procedure and SPL on noise annoyance are additive and independent. The effect sizes of the two effects indicate that the effect of SPL is somewhat stronger than that of procedure. The proportion of variance in annoyance scores uniquely explained by SPL is 10%, for procedure this proportion is 6%.

The effect of the SPL and procedure manipulations on the variables perceived control, effort, and respect, the proposed mediators of the procedure effect, is investigated with three separate ANOVAs (the results are reported in Table 4.III). For the actual mediation analyses, the indirect effects are estimated with a bootstrapping method (Shrout and Bolger, 2002) using the SPPS-macro provided by Preacher and Hayes (2004). This approach to mediation analysis is stated to be more accurate than traditional mediation analysis approaches (e.g., MacKinnon *et al.*, 2007). The SPSS-macro provides an estimate of the true indirect effect and its bias-corrected 95% confidence interval. In addition, the SPSS-macro generates the necessary output to assess the mediation using the traditional Baron and Kenny (1986) criteria, as well as a Sobel test of the observed indirect effect (Sobel, 1982). (The output of the mediation analyses is given in Table 4.IV.)

TABLE 4.III. Perceived control, effort, and respect scores (higher scores indicate higher perceived control, effort, respect) arranged by conditions of sound pressure level (SPL: low or high) and procedure (neutral or unfair). Cell means and marginal means (*M*), standard deviations (s.d.), and number of cases per cell (*N*) are given.

Potential mediator variable	**SPL**	**Procedure**	***M***	**SD**	***N***
Perceived	Low	Neutral	2.72	1.90	18
Control	50 dB	Unfair	2.62	1.65	26
		Total Low	2.66	1.74	44
	High	Neutral	2.75	2.02	20
	70 dB	Unfair	2.23	1.51	26
		Total High	2.46	1.75	46
	Total	Neutral	2.74	1.94	38
		Unfair	2.42	1.58	52
		Total	2.56	1.74	90
Effort	Low	Neutral	5.17	1.15	18
	50 dB	Unfair	3.92	1.74	26
		Total Low	4.43	1.63	44
	High	Neutral	3.95	1.50	20
	70 dB	Unfair	2.85	1.78	26
		Total High	3.33	1.74	46
	Total	Neutral	4.53	1.47	38
		Unfair	3.39	1.83	52
		Total	3.87	1.77	90
Respect	Low	Neutral	5.72	1.02	18
	50 dB	Unfair	4.35	1.41	26
		Total Low	4.91	1.43	44
	High	Neutral	6.30	0.80	20
	70 dB	Unfair	4.50	1.66	26
		Total High	5.28	1.62	46
	Total	Neutral	6.03	0.94	38
		Unfair	4.42	1.53	52
		Total	5.10	1.53	90

ANOVA with perceived control as the dependent variable and SPL and procedure as the independent variables indicates that the manipulations have not induced group differences in perceived control [SPL: $F(1,86)=0.23$, $p=0.64$, n.s.; procedure: $F(1,86)=0.70$, $p=0.41$, n.s.; SPL * procedure: $F(1,86)=0.30$, $p=0.58$, n.s.; equal error variances can be assumed: Levene's $F(3,86)=1.33$, $p=0.27$, n.s.; for cell means, see Table 4.III]. The Baron and Kenny (1986) criteria indicate no indirect effect of procedure on noise annoyance through perceived control. The total effect of the procedure on noise annoyance [indicated as $b(YX)$ in Table 4.IV] is statistically significant ($p < 0.05$). However, neither the effect of the procedure on perceived control [indicated as $b(MX)$ in Table 4.IV, $p = 0.40$, n.s.] nor the effect of perceived control on noise annoyance, controlling for the effect of procedure [indicated as $b(YM.X)$ in Table 4.IV, $p=0.45$, n.s.] are significant. The Sobel test of the indirect effect is highly insignificant ($p=0.67$, n.s.). The bootstrapped estimation of the true indirect effect of procedure on noise annoyance through perceived control is 0.01 [95% confidence interval (CI): −0.04 to 0.10; n.s.]. Hypothesis 4 that perceived control mediates the effect of procedure on noise annoyance is rejected. There is no indication that instrumental concerns explain the effect of procedural unfairness on noise annoyance.

ANOVA with effort as the dependent variable and SPL and procedure as the independent variables indicates that group differences in effort are induced by SPL as well as by procedure [SPL: $F(1,86)=11.23$, $p < 0.002$, $\eta^2=0.12$; procedure: $F(1,86)=11.77$, $p < 0.002$, $\eta^2 = 0.12$; SPL * procedure: $F(1,86)=0.04$, $p=0.84$, n.s.; equal error variances can be assumed: Levene's $F(3,86)=1.30$, $p=0.28$, n.s.]. The perceived effort made by the experimenter not to tax the participants unnecessarily is lower in the high SPL conditions than in the low SPL conditions [*M*(s.d.)high=3.33 (1.74) vs *M*(s.d.)low=4.43 (1.63)], and lower in the unfair procedure conditions than in the neutral procedure conditions [*M*(s.d.)unfair = 3.39 (1.83) vs *M*(s.d.)neutral = 4.53 (1.47); for cell means, see Table 4.III]. The Baron and Kenny (1986) criteria indicate an indirect effect of procedure on noise annoyance through effort. In addition to the significant effect $b(YX)$, both the effect of the procedure on effort [$b(MX)$, $p < 0.01$], and the effect of effort on noise annoyance, controlling for the effect of procedure [$b(YM.X)$, $p = 0.07$, one-tailed test: $p < 0.05$], are significant. Finally, the direct effect of procedure on noise annoyance, controlling for effort [indicated as $b(YX.M)$ in Table 4.IV; p=0.15] is reduced relative to the direct effect $b(YX)$. However, the Sobel test of the indirect effect of procedure on noise annoyance through effort is not significant (p=0.12). The bootstrapped estimation of the true indirect effect is 0.13, but it is only marginally significant from zero (95% CI: −0.01 to 0.32, $p > 0.05$; 90% CI: 0.004 to 0.29, $p < 0.10$). It is concluded that the indirect effect of procedure on noise annoyance through effort is not significant at $p < 0.05$.

TABLE 4. IV. Output of the SPSS procedure (Preacher and Hayes, 2004) for estimating the indirect effect of procedure on noise annoyance through the respective proposed mediators perceived control, effort, and respect. The results are organized by proposed mediator variable. For the observed direct and total effects among the independent (*X*), the dependent (*Y*), and the mediator variable (*M*), the *B* coefficients (*B* coeff) and standard error (s.e.), *t*-statistic, and two-tailed *p* values are given. For the indirect effect of the independent on the dependent through the mediator, a Sobel significance test for the observed indirect effect, and a bootstrap estimation and confidence intervals of the true mean are given. The sample consists of 90 records. For each bootstrap estimation 3000 resamples are taken.

Proposed Mediator Variable	**Statistics for direct, total, and indirect effects between Procedure (X), Noise Annoyance (Y), and proposed mediator variable (M)**				
Perceived Control	*Direct and total effects*				
	Effect	B-coeff.	s.e.	*t*	*p*
	b(YX)	0.43	0.20	2.13	0.04
	b(MX)	-0.31	0.37	-0.85	0.40
	b(YM.X)	-0.04	0.06	-0.76	0.45
	b(YX.M)	0.42	0.21	2.05	0.04
	Indirect effect and significance using normal distribution				
		value	s.e.	z	*p*
	Sobel	0.01	0.03	0.42	0.67
	Bootstrap results for indirect effect				
		mean	s.e.	LL95%CI	UL95%CI
	effect	0.01	0.03	-0.04	0.10
Effort	*Direct and total effects*				
	Effect	B-coeff.	s.e.	*t*	*p*
	b(YX)	0.43	0.20	2.13	0.04
	b(MX)	-1.14	0.36	-3.18	0.00
	b(YM.X)	-0.11	0.06	-1.85	0.07
	b(YX.M)	0.31	0.21	1.45	0.15
	Indirect effect and significance using normal distribution				
		value	s.e.	z	*p*
	Sobel	0.13	0.08	1.54	0.12
	Bootstrap results for indirect effect				
		mean	s.e.	LL95%CI	UL95%CI
	effect	0.13	0.09	-0.01	0.32

To be continued...

TABLE 4. IV. Continued.

Proposed Mediator Variable	Statistics for direct, total, and indirect effects between Procedure (X), Noise Annoyance (Y), and proposed mediator variable (M)				
Respect	*Direct and total effects*				
	Effect	B-coeff.	s.e.	*t*	*p*
	b(YX)	0.43	0.20	2.13	0.04
	b(MX)	-1.60	0.28	-5.72	0.00
	b(YM.X)	-0.04	0.08	-0.48	0.63
	b(YX.M)	0.37	0.24	1.56	0.12
	Indirect effect and significance using normal distribution				
		value	s.e.	z	*p*
	Sobel	0.06	0.13	0.47	0.64
	Bootstrap results for indirect effect				
		mean	s.e.	LL95%CI	UL95%CI
	effect	0.06	0.13	-0.20	0.32

ANOVA with respect as the dependent variable and SPL and procedure as the independent variables indicates that group differences in respect are induced only by procedure [SPL: $F(1,86)=1.70$, $p=0.20$, n.s.; procedure: $F(1,86)=32.08$, $p < 0.001$, $\eta^2=0.27$; SPL * procedure: $F(1,86)=0.57$, $p=0.45$, n.s.; due to unequal error variances with the higher error variance in the groups with a larger N, the F statistic is more conservative [Levene's $F(3,86)=4.01$, $p < 0.02$]. The perceived respectfulness of the treatment by the experimenter is lower in the unfair procedure conditions than in the neutral procedure conditions [M(s.d.)unfair=4.42 (1.53) vs M(s.d.)neutral = 6.03 (0.94); for cell means, see Table 4.III]. In none of the conditions, the treatment by the experimenter is perceived to be disrespectful. The Baron and Kenny (1986) criteria indicate no indirect effect of procedure on noise annoyance through respect. The effect $b(YX)$, and the effect of the procedure on respect [$b(MX)$, $p < 0.01$, see Table 4.IV] are significant, but the effect of respect on noise annoyance, controlling for the effect of procedure [$b(YM.X)$, $p = 0.63$, n.s.] is not significant. The Sobel test of the indirect effect of procedure on noise annoyance through respect is insignificant, too ($p=0.64$, n.s.). The bootstrapped estimation of the true indirect effect is 0.06, but it is highly insignificant (95% CI: −0.20 to 0.32; n.s.).

Hypothesis 5, which holds that relational concerns mediate the effect of procedure on noise annoyance, has not been tested with the intended scale for relational concerns. Instead, two separate analyzes have been used to test the indirect effect of procedure on noise annoyance through the two individual items (effort and respect). Both analyses have failed to find a significant indirect effect. Considering the results of these two mediation analyses, hypothesis 5 is rejected.

4.4 CONCLUSIONS

In the present paper, a social psychological approach to noise annoyance, rooted in theory, is proposed and experimentally tested. The core idea is that any sound is indissolubly associated with its source and that therefore being exposed to man-made sound is a social experience. A person's evaluation of the sound is affected by the social process between themselve(s) and the operator(s) of the source. The results from the laboratory experiment confirm that the unfairness of the sound management procedure influences the evaluation of the sound. Relative to a neutral sound management procedure, an unfair procedure is found to yield collective excess annoyance. Defining exposure to manmade sound as a social experience furthers the theoretical understanding of noise annoyance, which may well inspire new approaches to the abatement and prevention of noise annoyance.

The current results indicate that both the sound pressure level and the unfairness of the sound management procedure affect noise annoyance. The two effects are independent and additive. In the earlier studies on procedural fairness and noise annoyance (Maris *et al.*, 2007; 2004) the procedure effect interacted with the sound pressure level. For the current experiment, no expectation has been formulated regarding an interaction effect of SPL and procedure. It is found that the procedure effect has the same strength in both SPL conditions. The sound has not triggered a stronger procedure effect when it is both unwanted and loud (unfair, high SPL condition) than when it is unwanted but not loud (unfair, low SPL condition). What explains the absence of an interaction effect in the present study? One explanation is that outcome negativity is a dichotomous rather than a continuous variable:

An outcome is then perceived to be either negative or not, and hence no intensities of negativity are discerned. An-other explanation is that the increase (or decrease) of noise annoyance due to a procedure effect is limited to about half a scale point. It is most likely, however, that due to a ceiling effect in the unfair-high SPL conditions no increased procedure effect has been found. The average annoyance score in the unfair-high SPL condition [*M*(s.d.)= 6.14 (0.83)] indicates that most participants already scored either 6 or 7 on the seven-point scale.

Some issues of validity need to be addressed. With regard to the fairness manipulation, it appears to be difficult to create a truly unfair procedure in a lab situation. Although the unfair procedure is significantly less fair than the neutral procedure, in an absolute sense the unfair procedure is perceived to be only marginally unfair. Possibly, in an experimental setting, the participants expect not to receive voice, causing its absence not to be felt as a salient violation of an (implicit) fairness norm. Given the significant effect of the procedure on noise annoyance it can be argued that it is the level of (un)fairness relative to a collective norm, and not so much the exact point on the fair—unfair continuum, that matters. Further research is needed to study the effect of strongly unfair procedures, as well as the effects of other procedural fairness criteria on noise annoyance.

The manipulation check for the perceived fairness of the procedure indicates that the sound pressure level of the aircraft sound has influenced the perceived fairness of the sound management procedure. When participants have listened to the 70 dB sample, they perceive the procedure to be fairer than the participants who have listened to the 50 dB sample. Since higher procedural fairness is associated with lower noise annoyance levels, this effect can have reduced the strength of the annoying effect of the SPL manipulation. The effect of SPL on the perceived fairness of the procedure is no alternative explanation for the effect of the procedure manipulation on noise annoyance.

Third, in the laboratory the interpersonal distance between the exposed and the operators of the source is relatively small. One may wonder whether effects of social processes on evaluations of noise can be replicated when the interpersonal distance between the exposed and the operators of the source is big (as is often the case in field settings), or when a real person to interact with is lacking altogether (e.g., when the noise source is an institution). There is, however, evidence that people have a strong tendency to attribute social meaning to situations. For instance, research has shown that most people spontaneously and effortlessly ascribe motivations, intentions, and interactive behaviors to geometrical shapes moving about in a silent cartoon animation (e.g., the shapes are said to chase each other, or play, and to get frightened or elated) (e.g., Heider and Simmel, 1944; Klin, 2000). Other studies have shown that it is common for users of mass media to form so-called parasocial relationships with media figures (like celebrities, but also cartoon characters, or even magazines), in which the user responds behaviorally and cognitively to the media figure as though in a typical social relationship (e.g., Giles, 2002; Horton and Wohl, 1956; Cohen, 2004). Open interviews with people annoyed by the sound of wind turbines in Sweden illustrate that people perceive some kind of social relationship with the owner of the wind turbine, and perceive its annoying sound as a violation of social norms (Pedersen, *et al.*, 2004). In sum, it is important to consider the difference between laboratory and field setting but it seems warranted to make careful generalizations from the current results to field settings.

With regard to the quality of the sound manipulation, some remarks need to be made. The recording and play back of the sound will not have created an optimal soundscape. Still, it is not likely that sound quality issues endanger the conclusions drawn from the data. The sound quality has been identical for all participants, ruling out the possibility that the effects found are due to artefacts of sound quality differences. In addition, research has indicated that the cognitive responses to “source events” (as opposed to “background sound” where the source is not easily identifiable) are rather robust to changes in sound reproduction method (Guastavino *et al.*, 2005). The current authors have no reason to expect that the effect of procedural fairness on noise annoyance found in the experiment will be an artefact due to the quality of the sound reproduction.

A surprising number of participants have indicated not to dislike aircraft sound. (In total 10.9% of the participants choose aircraft sound, against 13.6% radio sound and 75.5% nature sound.) A preliminary exploration of the arguments participants give for choosing aircraft sound indicates that they are used to hearing aircraft sound in their home situation, or they expect that its presumed monotony will not distract them as much as the spoken words audible in the radio sample or the twittering bird song in the nature sample.

Based on the results of the explorative mediation analyses, it cannot be concluded whether instrumental or relational concerns mediate the effect of procedural fairness on noise annoyance. Some remarks can be made. The proposed mediation by instrumental concerns is not confirmed by the data. The perceived control scores indicate that participants in general experienced very little control over the sound, and that neither of the manipulations has induced differences in perceived control. Given the fact that many studies have demonstrated an influence of perceived control on evaluations of noise (e.g., Glass and Singer, 1972), it seems advisable not to discard perceived control as a mediator of procedure effects too aptly. To investigate whether procedure effects on noise annoyance can be mediated by instrumental concerns, future studies need to apply manipulations of procedural fairness designed to induce differences in perceived control, and assess perceived control in a more advanced way.

The explorative analysis of mediation of the procedure effect on noise annoyance by relational concerns has yielded mixed results. First, the two items intended to assess the regard of the experimenter (effort and respect) appear not to tap one and the same concept. The procedure manipulation has induced strong differences in perceived respect, but those differences do not translate into differences in noise annoyance. The procedure-induced differences in effort, on the other hand, are considered a mediator of the procedure effect on noise annoyance according to the Baron and Kenny (1986) criteria. Even though the indirect effect of procedure on noise annoyance through effort is only marginally significant, it seems premature to discard relational concerns as a mediator of procedure effects on noise annoyance. Future research is needed to construct a reliable and valid relational concern scale.

Noise annoyance is not solely a function of the characteristics of the acoustic stimulus. In the experiment, the fairness of the sound management procedure is an important determinant of noise annoyance besides the sound pressure level. Therefore, instead of marginalizing deflections from the dosage-response curve as "response bias," such deflections need to be recognized as a key to a better understanding of the psychology of noise annoyance that can be a guide toward innovative abatement strategies. As a practical consequence, inventories and action plans aiming at the prevention or abatement of noise annoyance need to search for and address the social processes that influence the sound evaluation [for practical suggestions, see Fields *et al.* (2000)]. It is important to know whom people perceive to be the operators of the source, how the sound management procedures are evaluated, and according to which criteria. Social psychological theories of justice offer a range of procedural fairness criteria that may be of practical use. There will be cultural differences with regard to which type of procedure people regard as just, but the wish to be treated justly seems to be universal (Montada, 2001). Unsound management is best avoided.

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