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Policy and the evaluation of aircraft noise

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ABSTRACT

In this paper, we hypothesize and test the ideas that (1) people's subjectivity in relation to aircraft noise is shaped by the policy discourse, (2) this results in a limited number of frames towards aircraft noise, (3) the frames inform people how to think and feel about aircraft noise and (4) the distribution of the frames in the population is dependent on structural variables related to the individual. To reveal subjects' frames of aircraft noise a latent class model is estimated based on survey data gathered among a sample of 250 residents living near Amsterdam Airport Schiphol, a major international airport in the Netherlands. In line with expectations, the results show that there are four evaluative frames of aircraft noise, three of which are strongly linked to the policy discourse. The frames are shown to legitimate different degrees of annoyance response. In turn, frame membership is influenced by two structural variables, namely aircraft noise exposure and noise sensitivity. The results indicate that in the explanation of subjective reaction to noise social factors operate discursively, while psychological factors operate within a traditional cause-and-effect model. The paper concludes with several policy implications.

INTRODUCTION

Noise annoyance is one of the main consequences of exposure to aircraft noise in residential areas. Previous research has consistently shown that the degree of noise annoyance is a direct function of the level of noise exposure (Fidell, Barber, & Schultz, 1991; Schultz, 1978). However, since humans are essentially interpretative beings, noise annoyance (by definition) arises within a particular evaluative context. Like exposure to noise this evaluative context may be regarded as a necessary condition to feel annoyed by aircraft noise.

The discourse resonance theory (Bröer, 2006, 2007; Bröer & Duyvendak, 2009) assumes that the evaluative context of aircraft noise is effectively shaped by the way policy actors conceptualize the noise problem. Based on work of Hajer (1995), Bröer (2006) expected that through a process of institutionalization one conceptualization of the noise problem would become dominant in the policy process. He assumed that the dominant policy discourse would resonate among people living near an airport and provide them with the necessary frames of reference to provide meaning to aircraft noise. A frame is defined here as a coherent set of beliefs, attitudes and feelings that people use to observe and give meaning to reality (see also Goffman, 1974; Schön & Rein, 1994).

In qualitative research, conducted at Amsterdam Schiphol (The Netherlands) and Zürich-Kloten (Switserland), Bröer (2006) indeed found dominant policy discourses for each airport: noise as an environmental problem (Amsterdam) and noise as a distributional problem (Zürich). As expected, these conceptualizations resonated among the residents living near these airports and shaped the evaluative frames to feel annoyed. In sum, the frames found among the general public resembled the collective public representations of the noise problem. In a follow-up study Kroesen and Bröer (2009) used Q-methodology to quantitatively investigate people's evaluative frames at Amsterdam Schiphol. The study revealed five frames related to the topic of aircraft noise, three of which were strongly linked to the policy discourse. The frames legitimized or delegitimized different degrees of annoyance response.

The aim of the Q-study of Kroesen and Bröer (2009), in line with the study of Bröer (2006), was to identify generalized ways of thinking and feeling towards aircraft noise. In both studies the sample was small and strategically chosen to ensure that all possible frames would be revealed. It therefore remained unknown to what extent the revealed frames would be present among the population of residents living near Schiphol airport. In addition, given the small sample size the frames could not be linked to structural variables related to the individual (e.g. personal dispositions) .

The main aim of the present study is to validate the frames and generalize them towards the population of residents living within the 45 Lden dB(A) contour of Amsterdam Schiphol. In addition, we investigate the effects of two structural variables, i.e. aircraft noise exposure and noise sensitivity, on frame membership. To attain these aims we estimate a latent class model based on data from a community survey conducted in 2008 at Amsterdam Airport Schiphol. Latent class analysis can be used to reveal the (latent) classes that underlie an observed pattern of correlations between a set of indicators (McCutcheon, 1987). Similar to Q-methodology latent class analysis can therefore identify general ways of thinking towards an issue. Unlike Q-methodology, however, the sample size is unlimited. It is therefore a suitable method to quantitatively validate the frames and generalize them towards a population. This document is a Microsoft Word template and should be used as the basis for all formatting of papers submitted to ICA 2010. Papers prepared on other word processing programs are acceptable but they should, so far as possible, conform to this format. Authors are fully responsible for their papers, which should not have been published elsewhere. They must have taken necessary steps to obtain permission for using any material that might be protected by copyright.

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THEORY AND CONCEPTUAL MODEL

In the following the discourse resonance theory will be described and two studies that applied the theory will be discussed. The section concludes with the development of a conceptual model to verify the theory for a representative sample of the population living near Schiphol airport.

A description of the discourse resonance theory

The discourse resonance theory developed by Bröer (2006), posits that people, when confronted with an environmental stressor like aircraft noise, adopt shared collective frames to evaluate it. According to Bröer (2006) these common frames result from the interaction of individual pre-existing mindsets and the dominant policy discourse. A dominant policy discourse is defined here as a shared conceptualization of public actors towards a policy issue, which has been institutionalized in policy (Hajer, 1995). Bröer (2006) identifies two possible outcomes of the interaction between the (macro) policy discourse and the (micro) individual frames: consonance and dissonance. People can either support the policy discourse (consonance) or partly diverge from and partly support it (dissonance). Consonance means that the policy discourse 'strikes a responsive chord' in people. This happens when the policy discourse is perceived to be in line with people's own cognitions and feelings. As a result, people will tend to reproduce the discourse. Dissonance also means that a responsive chord is struck, but that the policy discourse is perceived to be internally inconsistent or inconsistent with already existing cognitions and feelings. As a result, people will only partially reproduce the policy discourse and partially oppose or diverge from it. Consonance and dissonance both constitute forms of resonance of individual frames with the macro policy frames (Bröer, 2006). Bröer (2006) also identifies a third option, which he calls autonomy. In this case people derive their evaluative frame of reference from another source than the dominant policy discourse.

Through resonance the noise policy discourse shapes the individual frames of people. In turn, these frames act as the evaluative contexts to feel (or not feel) annoyed by aircraft noise. Hence, they contain certain 'feeling rules' (Hochschild, 1979). According to Hochschild (1979) individuals often work to induce feelings which are considered appropriate given their perception of the situation. So if the policy identifies aircraft noise as an important problem, and this definition resonates among those people who are affected by aircraft noise, they will 'work' to feel annoyed by the noise.

Applications of the discourse resonance theory

To verify the discourse resonance theory Bröer (2006) studied the (macro) policy discourse and (micro) individual frames at two airports: Amsterdam Schiphol and Zürich-Kloten. At both airports he found that the macro policy discourse posited growth of air mobility as necessary for the national economy. In order to compete in a globalizing economy growth was assumed to be inescapable. According to Bröer (2006), this trend argument (growth is natural/ inescapable) was dominant in both countries and formed the contextual background of the noise policy, which did differ across the two countries.

In the Netherlands he found that aircraft noise was conceptualized as an environmental problem that needed to be addressed through central planning measures. The underlying idea was that through careful planning the airport would be able to grow, while aircraft noise in residential areas could largely be avoided. During the 1980s this positive-sum logic became explicit with the ideas of 'ecological modernization' (Hajer, 1995) resulting in what Bröer termed the mainport and environment discourse. He showed how central policy measures (a new runway and collective cumulative noise limits) could be seen as institutionalizations of this line of thought. In Switzerland, on the other hand, he found that noise was conceptualized as a distributional problem. Here, citizens were informed by political actors that flight paths might be distributed differently. Within this discourse aircraft noise became conceptualized as a threat to the local community. This led to a zero-sum game, in which local communities stood up for the protection of their local 'soundscape', often at the cost of other communities.

In studying the individual frames of residents at both airports Bröer (2006) indeed found that people in their everyday conversations about aircraft noise adopt the logic of the policy discourse. At Schiphol airport, he found one consonant and two dissonant frames. The consonant frame ('mainport and environment') replicated the positive-sum logic of the Dutch policy. Residents in this frame believed that development of the airport and noise control could be achieved at the same time. In contrast, the dissonant frames only reproduced part of the policy discourse and thereby assumed a trade-off logic. The first dissonant frame, 'don't complain', replicated only the economic or 'mainport' argument. In this frame, the environmental argument was downplayed and complainants were ridiculed. The second dissonant frame, 'free state Schiphol', showed the opposite pattern, and only supported the argument of aircraft noise as an important environmental threat. In this frame, the economic benefits of the airport were criticized and air mobility was conceptualized as a being out of control.

At Zürich-Kloten, Bröer (2006) found one consonant and three dissonant frames. The consonant frame replicated both the trend argument (growth is inescapable/natural) and aircraft noise as a distributional problem (noise must be fairly distributed). The first dissonant frame, 'exaggerated annoyance', resembled the non-complaining frame at Schiphol airport. It emphasized the benefits of the airport and denied the existence of any real annoyance. The second dissonant frame, 'local resistance', emphasized only the second part of the discourse (distribution). Following this part it defined aircraft noise as a threat to the local community and legitimized (local) action to oppose aircraft noise. The third dissonant frame, 'limits to distribution', criticized the trend argument and defined aircraft noise not as a local but as a general problem.

At both airports, Bröer (2006) also found instances of autonomy: 'noise as the violation of a basic human right' and 'noise as a local problem' at Schiphol airport and 'noise as contextual problem' (evaluation of aircraft noise in relation to other noise sources) and 'noise as an environmental problem' at Zürich-Kloten. In both cases the percentage of autonomous frames was approximately 10%. Consonant and dissonant frames both constituted approximately 45% in the two samples.

Lastly, following Hochschild's (1979) notion of feeling rules Bröer (2006) showed how the frames legitimized or delegitimized different annoyance responses (Table 1). Consonant frames produced an annoyance score consistent with the overall average score of the respective cases. The dissonant frames 'don't complain' and 'exaggerated annoyance' produced an average annoyance score below the overall average, while the dissonant frames 'free state Schiphol'. 'local resistance' and 'limits to distribution' produced an average annoyance score above the overall average. However, given the fact that subjects were sampled from a single neighborhood (to keep the physical aircraft noise exposure level constant), these differences are not necessarily representative for the population.

Table 1. Marco discourse, micro frames and average aircraft noise annoyance scores

Amsterdam Schiphol (mainport and environment)	
Micro frame	**Average annoyance score (0-10)**
Consonant	4.5
Dissonant - don't complain	1.0
Dissonant - free state Schiphol	5.4
Autonomous	5.4
Overall average (n=36)	4.3
Zürich-Kloten (distribution)	
Micro frame	**Average annoyance score (0-10)**
Consonant	2.5
Dissonant - local resistance	6.4
Dissonant - exaggerated annoyance	0.4
Dissonant - limits to distribution	5.0
Autonomous	2.9
Overall average (n=34)	3.3

Source: (Bröer, 2006)

Bröer used an interpretative approach to identify the individual frames (only noise annoyance was quantitatively measured). To quantitatively objectify the frames Kroesen and Bröer (2009) applied Q-methodology in a follow-up study among residents at Amsterdam Schiphol. In total, 5 frames were revealed: (1) 'long live aviation!', (2) 'aviation: an ecological threat', (3) 'aviation and the environment: a solvable problem', (4) 'aircraft noise: not a problem' and (5) 'aviation: a local problem'. The third frame, 'aviation and the environment: a solvable problem', was consonant with the policy discourse. It emphasized the economic benefits of aviation, but also (to a lesser extent) the environmental costs and proposed a technological 'fix' to resolve the tension (i.e. relocation of the airport to the sea). The first two frames, 'long live aviation!' and 'aviation: an ecological threat' respectively resembled the dissonant frames 'don't complain' and 'free state Schiphol' found by Bröer. The last two frames, 'aircraft noise: not a problem' and 'aviation: a local problem', were identified as instances of autonomy. 86% of the participants in the sample loaded on one of the first three frames, again indicating that the policy discourse resonated (be it consonant or dissonant) broadly among the subjects.

Consistent with findings of Bröer (2006) the frames were associated with different degrees of annoyance response (Kroesen and Bröer, 2009).

Summarizing, it can be concluded that the discourse resonance theory has been successfully applied to understand people's perception and evaluation of aircraft noise. However, several knowledge gaps still exist. Specifically, it is unknown (1) how the frames are distributed among the population of residents, and (2) whether and to which extent structural variables related to the individual influence this distribution. The conceptual model described in the next section is developed to fill these gaps.

Conceptual model

Based on the discourse resonance theory we hypothesize that the evaluative context of aircraft noise at Schiphol airport consists of four frames, three of which are linked to the policy discourse: 'mainport and environment' (consonance), 'don't complain' (dissonance) and 'free state Schiphol' (dissonance). We expect that only a small portion of the population will be unaffected by the policy (autonomy). Based on the notion of feeling rules we hypothesize that each frame produces an 'appropriate' response in terms of feeling annoyed by aircraft noise.

To address the question why people end up in the particular frames as they do, we identify two variables which we hypothesize will predict frame membership. The first is the physical level of aircraft noise exposure. Previous research has consistently shown that this variable is associated with people's reaction to noise (Fidell, Barber, & Schultz, 1991; Miedema & Oudshoorn, 2001; Quehl & Basner, 2006; Schultz, 1978). We therefore expect that the proportions of people subscribing to the varying frames will be related to the aircraft noise level. Specifically, we hypothesize that at low exposure levels people will mainly express themselves in the 'don't complain'-frame while at high exposure levels people will mainly adopt the 'free state Schiphol'-frame.

The second structural variable is an individual dispositional variable previously shown to be associated with noise reaction, namely noise sensitivity (Stansfeld, 1992; Van Kamp et al., 2004; Zimmer & Ellermeier, 1999). Research has shown that noise sensitivity is empirically unassociated with noise exposure (Job, 1988; Miedema & Vos, 2003). It can therefore be identified as a genuine determinant of noise reaction (and not as a possible reflection of noise reaction). Additionally, noise sensitivity has been shown to correlate with other aspects of a person's personality like neuroticism (Belojevic, Jakovljevic, & Aleksic, 1997; Stansfeld, 1992), adding to the evidence that noise sensitivity is a personal disposition. In this respect, a study among twin-pairs has also shown that noise sensitivity, with an estimated heritability of 36%, probably has a genetic component (Heinonen-Guzejev et al., 2005). In sum, noise sensitivity can be viewed as a structural variable related to the individual, and not as a variable related to people's everyday discourse about aircraft noise. We therefore hypothesize that noise sensitivity is not an indicator of frame membership but a determinant. Specifically, we expect that people with a general disposition to feel disturbed by sounds will express themselves in a frame which suits this disposition, in this case the 'free state Schiphol'-frame. The other way around, we expect that those not easily disturbed by sounds will (mainly) express themselves in the 'don't complain'-frame.

A third set of assumptions relate to the relationships between the determinants and indicators of the frames, which we hypothesize are mediated by frame membership. These assumptions reflect the idea that the frames are effective in capturing the full breadth of people's subjectivity in relation to aircraft noise. In other words, if no direct effects between the determinants and the indicators remain after accounting for the frames, it can be said that the frames indeed capture the relevant variance residing in the indicators.

In Figure 1 the full conceptual model is depicted. To summarize, we assume that people's subjectivity can be captured in a limited number of frames which exist in relation to the policy discourse. Conditional on the frame membership, we assume that the associations between the residual terms of the frame indicators (i.e. noise annoyance and concepts related to the policy discourse) are zero. This assumption reflects the idea that there are indeed a limited number of unobserved/latent categories (i.e. frames) that can effectively account for the observed relationships between the indicators. Additionally, we expect that frame membership will be associated with structural variables related to the individual. Specifically, we expect that aircraft noise exposure and noise sensitivity will (independently from each other) predict frame membership. Finally, we assume that the frames will fully mediate the direct relationships between the determinants and the indicators of the frames.

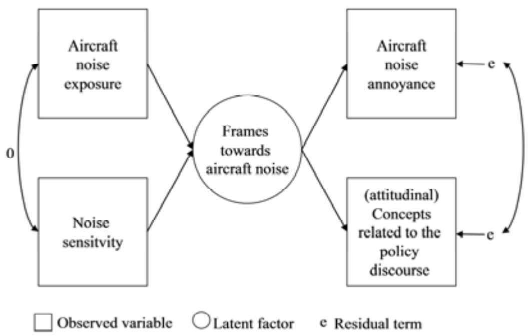

Figure 1. Conceptual model of aircraft noise annoyance

MATERIALS AND METHODS

Data

The data were gathered in a survey conducted in April 2008 among the population of residents living within the 45 Lden contour around Amsterdam Airport Schiphol . The survey represented a follow-up on a previous survey conducted two years earlier (in April 2006). To ensure representative sampling for this initial survey, we used data related to the numbers of people living in the municipalities within the 45 Lden contour around Schiphol. Based on these data and the total number of people within the 45 Lden contour (approximately 1.5 million people) we could calculate how many people per municipality needed to be included to arrive at an overall representative sample for the population within the 45 Lden contour. Proportional to the resulting figures varying numbers of residents were randomly approached within each municipality (7000 in total).

Those sampled were invited via a letter delivered at their home address to fill in an online questionnaire. With 646 useable responses the response ratio was 9.2%. The mean sample age of 49.8 deviated slightly from the population mean of 46.7. Additionally, residents with better education and a higher income were slightly overrepresented. At the end of the questionnaire respondents could indicate whether they would be willing to participate in a second survey. In all, 505 people were willing and provided their e-mail address. These people were again approached in April 2008. 269 people responded positively. 15 respondents were excluded from the analysis because their sex and age did not match between the two surveys, and another 4 were excluded because they had moved to a location outside the 45 Lden contour. The final response group consisted of 250 (=269-15-4) useable responses. Hence, the response rate for the second survey was 50.3%.

The low response rate can be problematic insofar as non-respondents differ from respondents on the variables of interest. In our particular case it is plausible that people who are exposed to higher levels of aircraft noise or who are more annoyed by the noise are also more inclined to participate in a survey about the airport. However, comparisons between respondents and non-respondents for the second survey showed that respondents were not exposed to higher exposure levels than the non-respondents and that their average annoyance score did not differ from the non-respondents, thereby excluding the presence of (non-)response bias. The low response rate was therefore not considered problematic.

Measures

Table 2 presents the used indicators and covariates of subjects' frames towards aircraft noise. The indicators were sampled from two previous studies (Kroesen & Bröer, 2009; Kroesen, Molin, & Van Wee, 2008) and are selected in such way that they capture the full theoretical domain of the frames towards aircraft noise. The first two indicators represent the domains of mainport and environment, capturing the essential features of the policy discourse. The next two items capture the attitudes towards Schiphol/aviation and complainants, two basic indicators of the dissonant frame 'don't complain'. The fifth and sixth indicator capture the features of the dissonant frame 'free state Schiphol': distrust in the government and feelings of powerlessness. The last indicator is reserved for noise annoyance, which, we hypothesized, derives from subjects' overall framing of the (noise) situation. There are no indicators included related to autonomous frames. This is not necessary since these frames are expected to display neutral positions in relation to the indicators described above. However, this does mean that we will not be able to distinguish between different autonomous frames, since they will all collapse into a single one.

Next, two inactive covariates are included. These variables do not contribute in the prediction of frame membership, but are merely included to aid in the interpretation of the different frames. The first inactive covariate is a second noise annoyance indicator. This item is related to the standardized noise annoyance question developed by Fields et al. (2001) and measures noise annoyance on an 11-point scale. This additional scale is included to compare the results with the previous studies of Bröer (2006) and Kroesen and Bröer (2009) (Tables 1 and 2), which also used this scale. The second covariate is related to complaint behavior. We expect that those in the 'don't complain'-frame will show the smallest probability of ever having lodged a complaint, while those in the 'free state Schiphol'-frame the highest.

The third and fourth covariate are included as active covariates, because they are hypothesized to influence frame membership. The third covariate constitutes the physical level of aircraft noise exposure. This variable is represented by the noise exposure metric Lden dB(A). For every respondent in the sample, the level of noise exposure (a year average level based on the 12-month period preceding the survey) is calculated by the National Aerospace Laboratory (NLR) in the Netherlands. This was done by transforming the four-digit two-letter postal code of each respondent's residence into XY-coordinates, which are subsequently used to determine the level of aircraft noise exposure at the particular location.

Finally, noise sensitivity is measured via a subset of 7 items of Weinstein's noise sensitivity scale (Weinstein, 1978). This subset has previously been shown to form a uni-dimensional and reliable scale (Kroesen et al., 2008). In the present study this result is reproduced with a reliability coefficient of 0.87.

Table 2. Indicators and covariates of residents' frames towards aircraft noise

Indicator
Schiphol is an engine of the economy.
Aviation is a threat to the environment.
Schiphol should be allowed to stay: Long live aviation!
If people complain about aircraft noise they pursue their self-interest.
They do not realize how important Schiphol is to The Netherlands.
I trust the government to uphold the noise norms for Schiphol.
I feel powerless in relation to the aircraft noise situation.
I feel annoyed by aircraft noise.
Covariate (inactive)
Aircraft noise annoyance (past 12 months)
Ever lodged a complaint about aircraft noise
Covariate (active)
Aircraft noise exposure in dB(A) L_{den}
Weinstein's sensitivity scale (sum score of 7 items)

Method

Latent class analysis is used to reveal the (latent) classes that underlie the response patterns on the set of indicators presented in Table 3. The main idea of latent class analysis is that a discrete latent variable can account for the observed associations between the indicators, such that, conditional on the latent class variable, these associations become insignificant (Hagenaars & McCutcheon, 2002; McCutcheon, 1987; Magidson & Vermunt, 2004). This is generally called the assumption of local independence. The goal is to find the most parsimonious model, i.e. with the smallest number of latent classes, which can adequately describe the associations between the indicators. Given that we hypothesized the existence of discrete latent categories (i.e. the four frames), latent class analysis is a suitable method to reveal these unobserved categories. Within the latent class model each class will represent a different evaluative frame of aircraft noise.

A latent class model has two kinds of parameters: the (unconditional) latent class probabilities and the (conditional) response probabilities. The latent class probabilities are the class prevalence estimates, which indicate the proportion of the sample assigned to each class (in this case to each frame of aircraft noise). The response probabilities indicate the percentages of class members responding positively (or negatively) to the indicators within the respective latent classes. The response probabilities are used to define each latent class.

Aircraft noise exposure and noise sensitivity are included as active covariates and are assumed to predict class membership. Their effects on class membership are estimated via a multinomial logistic regression model (Magidson & Vermunt, 2004). Aircraft noise annoyance (on an 11-point scale) and complaint behavior are included as inactive covariates and will not affect the estimated models.

The software package Latent Gold is used to estimate the models (Vermunt & Magidson, 2005). This package is especially developed for latent class analysis. It uses a combination of the Expectation-Maximization and the Newton-Raphson algorithm to calculate the maximum likelihood estimates. In addition, the package can generate multiple sets of random start values to avoid local maxima and find the global maximum.

RESULTS

Model selection

To assess the fit of the different models the chi-squared L2 statistic can be used (Vermunt & Magidson, 2005). This statistic indicates the amount of discrepancy between the model-implied and the observed cell frequencies of the response patterns. However, with 3^7=2187 (7 indicators with 3 categories) possible response patterns and a sample size of N=250 many response patterns are not observed. In the case of such sparse data testing model fit poses a problem because the L2 statistic does not follow a chi-square distribution. To overcome this problem the bootstrap approach has been developed to estimate the p-value of the L2 statistic (Langeheine, Pannekoek, & Van de Pol, 1996; Magidson & Vermunt, 2004). This method is therefore used in the present study. Another approach to assess model fit in the case of sparse data is the use of an information criterion, which weighs both model fit and parsimony (i.e. the number of estimated parameters). For the present study we included the adjusted Bayesian information criterion (Sclove, 1987), which (in a simulation study) has been shown to perform well in determining to correct number of latent classes (Nylund, Asparoutiov, & Muthen, 2007). The model with the lowest BIC value indicates the best fitting model.

Table 3. Results from latent class models fit to the sample data

Number of classes	L^2	*df*	Bootstrap p-value	S.E.	Adjusted BIC(LL)
1	1106.7	238	0.000	0.000	3585.1
2	691.6	223	0.002	0.002	3205.3
3	534.3	208	0.056	0.011	3083.5
4	475.2	193	0.080	0.011	3059.7
5	444.8	178	0.128	0.015	3064.7
6	424.9	163	0.056	0.010	3080.2
7	405.4	148	0.062	0.009	3096.1

L^2 = likelihood-ratio chi-squared statistic
df = degrees of freedom
S.E. = standard error of the bootstrap p-value
BIC(LL) = Bayesian information criterion (based on log-likelihood)

Table 3 presents the results of seven models in which 1 through 7 latent classes are successively specified. Since the main aim of the analysis is focused on validating the measurement part of the model (the relationships between the latent variable and the indicators) these models are estimated without the active covariates. The results show that the bootstrap p-values of the models with three or more classes are insignificant at the desired level of significance (i.e. 0.05). The 95%-confidence interval of the bootstrap p-value of the 3-class solution, however, ranges from 0.034 to 0.078 and partly falls below the desired level of significance. In the 4-class model this interval lies entirely above the standard criterion of 0.05. Examination of the adjusted Bayesian information criterion also indicates that the 4-class solution is optimal. Based on these results, which align well with our theoretical argument, we conclude that the four-class model is optimal.

Parameter estimates

Table 4 presents the profiles of the four-class solution. The parameters related to the (un)conditional probabilities are all significant ($p<0.05$), indicating that classes differ in size as well as form. Below the classes are discussed in terms of the unconditional and conditional response probabilities.

The first class compromising 32% of the sample can be identified as the dissonant frame 'don't complain'. Subjects in this frame express strong support for the mainport-argument. The majority is neutral towards the environmental argument, and a substantial portion even disagrees with it. All subjects in this frame are cheerful towards aviation. Nearly half of the subjects believe that complainants about aircraft noise pursue their self-interest because they do not appreciate the (economic) importance of Schiphol. Only a small portion distrusts the government to uphold the noise norms. Subjects in this frame do not feel powerless, nor do they feel annoyed by aircraft noise. On a scale from 0 to 10 the average annoyance score of subjects in this frame is 1.8.

The second class compromises 29% of the sample and can be identified as the consonant frame 'mainport and environment'. The majority in this class supports the statement that Schiphol is an engine for the economy. Although the mainport-argument is dominant, a substantial potion also agrees with the statement that aviation is a threat to the environment. The majority is neutral toward Schiphol and towards complainants. Within this frame there is a considerable amount of distrust towards the government. Subjects are generally neutral towards the statements related to feelings of powerlessness and aircraft noise annoyance. The average noise annoyance score of subjects in this frame is 5.0.

The third class compromises 24% of the sample and resembles the dissonant frame 'free state Schiphol'. Subjects in this frame express agreement with the statement that aviation is a threat to the environment and are neutral towards the mainport-argument. Subjects are strongly distrustful towards the government. They generally feel powerless in relation to the noise situation. The majority feels annoyed by aircraft noise. However, the average noise annoyance score of subjects, 6.0, is not extreme. This can be explained by the fact that the mainport-argument is not explicitly denied. Hence, economic benefits of Schiphol are, to some extent, acknowledged.

The last class can be identified as an autonomous frame. This class is the smallest of the four with 15% of the sample being assigned to it. In this frame subjects are neutral towards all statements, providing no legitimization for feelings of powerlessness or annoyance. The average annoyance score in this frame is 3.0.

Both the unconditional and the conditional probabilities are in line with the expected patterns. Consistent with the studies of Bröer (2006) and Kroesen and Bröer (2009), the majority of the sample (85%) adopts the logic of the policy discourse to structure their evaluative frames of aircraft noise. It can therefore be concluded that the definitions of the frames as well as their sizes align well with our theoretic expectations.

Another interesting result is that the mainport-argument dominates the environmental argument. This dominance is manifested in three ways: (1) the greatest portion of the sample assigned to the 'don't complain' class, favoring further growth of aviation (2) in the consonant frame 'mainport and environment', support for the economic argument is greater than for the environmental argument and (3) none of the frames explicitly denies the mainport-argument. Related to this last point, we can observe that, the other way around, the 'don't complain'-frame does, to some extent, deny the environmental argument. In effect, we can observe a frame with an (extremely) low annoyance response ('don't compain'), but not an opposite frame with an (extremely) high annoyance response.

Finally, it can be observed that the frames are also predictive for complaint behavior. Subjects in the 'don't complain'-frame have the smallest probability of ever having lodged a complaint about aircraft noise, while those in the 'free state Schiphol'-frame the highest.

Table 4. Unconditional and conditional class probabilities of the 4-class model

	Class			
N=250	**1**	**2**	**3**	**4**
Class size	0.32	0.29	0.24	0.15
Indicators				
Schiphol is an engine of the economy.				
Disagree	0.00	0.00	0.20	0.05
Neutral	0.11	0.44	0.57	0.79
Agree	0.89	0.56	0.23	0.16
Aviation is a threat to the environment.				
Disagree	0.42	0.03	0.07	0.00
Neutral	0.49	0.56	0.25	0.96
Agree	0.09	0.41	0.68	0.04
Schiphol should be allowed to stay: Long live aviation!				
Disagree	0.00	0.00	0.53	0.00
Neutral	0.00	0.71	0.46	0.77
Agree	1.00	0.29	0.01	0.22
If people complain about aircraft noise they pursue their self-interest.				
Disagree	0.09	0.25	0.83	0.01
Neutral	0.46	0.72	0.12	0.83
Agree	0.45	0.03	0.05	0.16
I trust the government to uphold the noise norms for Schiphol.				
Disagree	0.10	0.43	0.90	0.04
Neutral	0.46	0.54	0.05	0.86
Agree	0.44	0.03	0.05	0.10
I feel powerless in relation to the aircraft noise situation.				
Disagree	0.68	0.00	0.10	0.49
Neutral	0.22	0.63	0.17	0.51
Agree	0.10	0.37	0.73	0.00
I feel annoyed by aircraft noise.				
Disagree	0.86	0.13	0.13	0.59
Neutral	0.14	0.65	0.26	0.41
Agree	0.00	0.22	0.61	0.00
Inactive covariates				
Noise annoyance (0-10)				
Mean	1.8	5.0	6.1	3.0
Lodged a complaint				
No	0.92	0.75	0.60	0.88
Yes	0.08	0.25	0.40	0.12

Active covariates

As expected, and in line with previous research, there is no significant correlation between the two active covariates, i.e. aircraft noise exposure and a person's general disposition to be sensitive to noise. In addition, both variables are significantly associated with frame membership (aircraft noise exposure, Wald statistic=11.08, p=0.011; noise sensitivity, Wald statistic=34.50, p=0.000). Finally, their inclusion leads to a good model fit (L2=2746.5, pbootstrap=0.228) indicating that the latent class variable indeed mediates the effects of both variables on the indicators of the frames. Substantively this means that the latent variable is effective in capturing the relevant variance residing in its indicators.

In Figure 2 the relationships between the covariates and frame membership are plotted. It can be observed that at low noise exposure levels the 'don't complain'-frame is dominant. At high exposure levels the majority of the subjects is assigned to the frames 'free state Schiphol' and 'mainport and environment'. The autonomous frame decreases slightly with increasing noise levels. A plausible substantive explanation is that at high exposure levels people will feel forced to take an explicit position in relation to the policy discourse.

The relationship between noise sensitivity and frame membership shows a similar pattern. Subjects who indicate they are not sensitive to noise mostly belong to the ‘don’t complain’-frame, while those sensitive to noise mainly express themselves in the frames ‘free state Schiphol’ and ‘mainport and environment’. The autonomous frame is relatively stable along the full range of noise sensitivity.

In line with expectations, it can be concluded that the distribution of the frames is dependent on two structural variables, one related to the individual’s situational context (i.e. the level of aircraft noise exposure) and the other to a person’s general disposition to feel annoyed by noise.

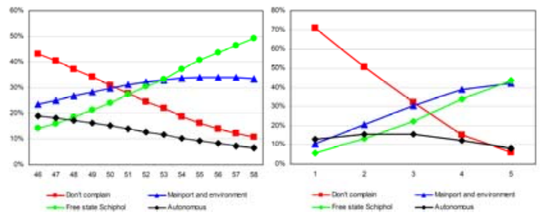

Figure 2. Relations between aircraft noise exposure in Lden dB(A) and frame membership (left) and noise sensitivity and frame membership (right)

Note: the range of noise sensitivity is rescaled to the interval [1-5]

DISCUSSION

In this section we will discuss the results in relation to previous statistical models which tried to explain individual differences in noise reaction and reflect on the adopted research method.

After accounting for noise exposure typically 70-80% of the individual variability in noise reaction remains (Job, 1988). Attempts to explain this variability have uncovered a range of factors which are empirically associated with noise annoyance. These factors can be categorized in psychological variables, like a person’s noise sensitivity (Stansfeld, 1992), and social variables, like a person’s attitude toward the noise source (Job, 1988). Typically, the attitudinal variables are found to be stronger determinants of noise reaction than the psychological variables.

In this paper we have tested a model that provides a theoretical explanation for the strong associations between noise annoyance and the attitudinal (social) variables. We have hypothesized that they can be treated as part of an underlying factor, which consists of a limited number of categories. Specifically, we expected that the correlations between noise annoyance and social variables arise from a limited number of evaluative frames towards aircraft noise.

This conceptualization stands in contrast with previous models that aimed to explain individual variability in noise annoyance (see e.g. Staples, Cornelius, & Gibbs, 1999, Alexandre, 1976 and Kroesen et al., 2008). The left side of Figure 3 presents the general structure of these previous models. In words, this conceptualization assumes that variance in noise annoyance can be explained by noise exposure, psychological variables and attitudinal variables, while controlling for the intercorrelations between these determinants. The present model, in contrast, assumes that a latent factor underlies both the attitudinal variables (in this case the arguments related to the policy discourse) and aircraft noise annoyance. Psychological variables, on the other hand, are assumed to influence noise annoyance indirectly via frame membership. The present study has shown that these hypotheses can both be theoretically and empirically supported.

In effect, the present model provides a more insightful perspective on how social and psychological factors actually influence subjective reaction to noise. Social factors (attitudes/arguments) do not ‘cause’ noise annoyance but operate discursively; they set limits on what can arguably be said and felt in a particular situation, resulting in a limited number of socially ‘viable’ positions. In our case, for example, a frame legitimizing an (average) extreme annoyance response is not viable, because of the dominance of the mainport-argument. People would need to go to great length to rationalize such a position in relation to others. Psychological factors, i.e. a person’s personality, can be said to operate within a traditional cause-and-effect model. They (at least partly) determine in which of the existing socially viable perspectives a person ends up.

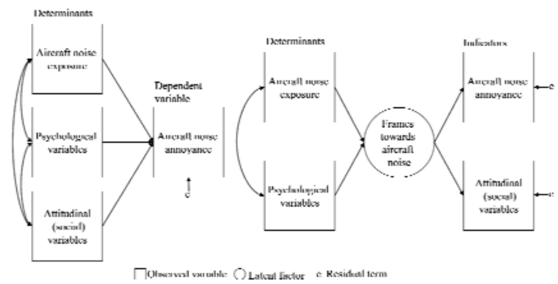

Figure 3. The general structure of previous conceptualizations to explain individual variability in noise annoyance (left) versus the conceptualization adopted in the present paper (right)

CONCLUSION

The present study has provided an additional verification of Bröer’s (2006) discourse resonance theory. Consistent with this theory we found that people develop their evaluative frames of aircraft noise in relation to the (dominant) policy discourse, and either entirely reproduce this discourse (consonance), or partly reproduce it and partly oppose it (dissonance). Only a small portion of the population derives its evaluative frame from another source than the policy discourse. According to their varying definitions of the noise situation, the frames are associated with ‘appropriate’ degrees of annoyance response. In other words, the policy discourse shapes and thereby limits what can be legitimately said and felt about aircraft noise. The policy discourse can therefore be said to operate discursively. It does not determine in which frame a person ends up, yet it does determine which frames are socially viable. Within the resulting discursive space people cannot easily develop an idiosyncratic frame. Additionally, the present study has shown that frame membership is influenced by two structural variables related to the individual, namely aircraft noise exposure and noise sensitivity. These structural variables can be said to operate within a traditional cause-and-effect paradigm. They contribute in the determination of frame membership.

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