euronoise 2021
25th to 27th of October
Madeira, Portugal - online

Effect of media coverage about airport changes on aircraft noise annoyance during an airport study

Sarah Benz[1], Christin Belke[1], Dirk Schreckenberg[1]

[1]ZEUS GmbH, Centre for GmbH, Centre for Applied Psychology, Environmental and Social Research, Hagen, Germany
(benz@zeusgmbh.de, belke@zeusgmbh.de, schreckenberg@zeusgmbh.de)

Abstract
Research suggests that public policy discourse, socially shared information, and media coverage can influence one's perception of noise and its effects. Media coverage is expected to increase particularly in change situations of noise sources. The NORAH study (Noise Related Annoyance, Cognition and Health) investigated the effects of aircraft noise on people living near major airports in Germany while several changes were implemented at Frankfurt Airport. We documented media coverage during the study years. We conducted a media re-analysis within the ANIMA project, linking the media data to the aircraft noise annoyance ratings from a sample of 3,308 respondents. We condensed the news headlines to categories of topics like "night flight" and "protest". For each participant, news from 180 days prior to the study interviews were considered. Separate analyses were conducted to examine the influence of each category on aircraft noise annoyance.

Keywords: aircraft noise, media coverage, non-acoustic factors, noise annoyance

1 Introduction

The noise-specific health outcome 'noise annoyance' is the most common effect used to estimate the impact of noise on human-beings. Noise annoyance is also assumed to be associated with other health effects such as mental health [1][2] or cardiovascular diseases [e.g. [3]]. However, only about 1/3 of noise annoyance is explained by sound levels such als L_{den} or L_{dn} [4], although this varies between studies. However, other factors are thought to contribute significantly to the magnitude of noise annoyance. These so-called non-acoustic factors comprise factors unrelated to sound exposure but known to potentially modify noise responses [5]. They can be classified as personal and social factors (e.g. attitudes, noise sensitivity), physical and situational factors (e.g. temporal factors of a noise situation, access to recreational spaces) among others and are assumed to contribute to annoyance ratings [see [6][7]. One factor hypothesized to alter the perception and response to noise is media coverage about noise topics. Research on environmental noise sources, i.e. in wind turbine studies, suggest that when people get exposed to media material with information about noise participants' reaction to subsequent noise exposure was influenced accordingly [8][9]. Positive framed media material was associated with less negative reactions on noise, i.e. people reported less health complaints and lower annoyance rates in response to noise exposure [8][9], whereas exposure to negative information about noise resulted in higher noise annoyance rates and more health complaints [8][9]. This indicates that knowledge and information can influence (cognitive) reactions to external stimuli.

Another indicator that the distribution of information might affect people's perception of noise can be found in a study about public discussions about policy. In a study around two airport regions, Amsterdam and Zurich, it was found that policy discourse effected people's reasoning in annoyance ratings [10][11]: arguments from public policy discourse were used by residents to explain annoyance ratings. Policy discourse is usually covered in media coverage, therefore it can be assumed that the distribution via media contributed to a general distribution of these information. Media information further tends to get socially distributed, shared and discussed within one's social environment, both in an offline and online context.
In the current study we examine the potential effect of the portrayal of aircraft noise issues in the media on aircraft noise annoyance. In the course of the NORAH study a media analysis of aircraft-related media coverage was conducted. We explore whether there is a relationship between the frequency of reports about different aircraft noise-related topics and aircraft noise annoyance ratings during three study years. It is hypothesised that media information about aircraft noise topics might contribute to or even trigger noise responses.

2 Method

Within the scope of the EU-project ANIMA (Aviation Noise Impact Management through novel Approaches), a re-analysis of data from the NORAH study (Noise-related annoyance, cognition, and health; [12] was conducted. The NORAH study was a comprehensive research project investigating different physiological and psychological effects of aircraft noise, among others, on people living in the vicinity of airports in Germany. In the current study we focus on data that were collected in three annual survey waves during the study period from 2011 to 2013 in the course of the opening of a new runway as well as an implementation of a night flight ban at Frankfurt Airport in October/November 2011. Participants were invited to participate in the study with a cover letter. Offered survey modes were online participation and telephone interviews. Media articles from a press review were analysed [13]. We combined the media data collected during the project period with the NORAH WP1 survey data on the residents' noise annoyance (and sleep disturbance) [for WP1 survey report see [14]]. The aim of this re-analysis was to investigate whether media coverage during the study period had an influence on the aircraft noise annoyance and sleep disturbance ratings of participants.

2.1 Study area and participants

The study was conducted around Frankfurt Airport. The study area was defined using noise contours of continuous energy equivalent sound level during the day (L_{day}) and night (L_{night}) of air traffic. With noise levels 40 dB or higher buildings were included in the sampling pool. A stratified random sampling method was used: participants were randomly selected within 5 dB classes of noise levels. In this study we included data from participants who completed the survey in all three waves. In total, a sample data of 3,308 persons with a minimum age of 18 years were analysed.

2.2 Study material

Media material
The daily compilation of press articles provided by the airport operator Fraport AG was analysed. It contained articles on aircraft noise related topics. Only articles from pre-defined relevant sources and on relevant topics were screened for further analysis. The press review was analysed assessing the frequency of occurrence of specific aircraft and/or aircraft noise-related and/or aircraft-related terms with a text analysis program. The articles were assigned to different categories accordingly. In this study we analysed the following seven categories "sound insulation", "protest", "flight path", "sound exposure", "increase sound exposure", "night flight", and "mistrust/trust in authorities". The number of articles for each category per day

was documented, then the relative number of articles in each category per day in relation to the total number of relevant articles per day was calculated. Media coverage in this study is used as "mentioned in the media", regardless of the evaluative direction of the news report.

Survey questionnaire

In all three waves the same survey questionnaire was employed with only minor changes. Noise annoyance was assessed with the standardised question recommended by the International Commission on Biological Effects of Noise (ICBEN): „Thinking about the last 12 months, when you are here at home, how much does noise from aircraft bother, disturb, or annoy you?" [15][16], to be answered on a 5-point verbal scale from (1) *not at all* to (5) *extremely*. Sleep disturbance was assessed with an adapted version of the question asking for disturbances when falling asleep, sleep during the night and sleeping in. A mean score of the three sleep disturbance questions is calculated. Besides noise annoyance and sleep disturbances as our main concepts of interest in this analysis, the questionnaire further comprised questions assessing residents' living conditions and sociodemographic data among others.

Noise exposure

Address-specific equivalent sound levels and maximum sound levels were calculated for each participant, for further details see [17].

2.3 Statistical analysis

New media variables were calculated for each noise-related category of media coverage and each year of the study from 2011 to 2013. A media variable reflects the relative average media coverage of one media category as percentage of the mentioning of this category among all reports related to Frankfurt Airport in the press review for the 180 days prior to the interview date of each participant. The resulting values of all media variables were shown to be non-normally distributed (right-skewed), therefore variables were logarithmized for the regression analysis. Separate regression models were calculated for each media category due to high intercorrelations between media variables.
The influence of media coverage on annoyance ratings was analysed using generalized linear models (GZLM) with noise annoyance (or sleep disturbances, respectively) as the criterion variables. The predictor variables included in the models were media variables, different noise metrics (L_{den}, L_{night}) and the study year (2011, 2012, 2013). The reference year was set for 2013 as an anticipated auxiliary baseline. For each media category a separate regression was calculated.

3 Results

For a comprehensive overview of the study results see Deliverable D3.9. [18]. Descriptive statistics of the sample and regarding the media variables is reported in Table 1.
The average age of the sample at the beginning of the project in 2011 was 52.6 years (*SD*=14.6). The gender ratio was relatively balanced with 53.5% woman. Average sound pressure levels slightly decreased during the years from 2011 to 2013 for L_{den} and L_{night}. Average noise annoyance ratings in the sample were above 3 = moderately for all three years (2011: *M*= 3.3 (*SD*=1.3), 2012: *M*=3.4 (*SD*=1.3), 2013: *M*=3.2 (*SD*=1.3)). The average sleep disturbance score of the sample was over 2= slightly disturbed in all three years (2011: *M*=2.3 (*SD*=1.3), 2012: *M*=2.2 (*SD*=1.2), 2013: *M*=2.2 (*SD*=1.2)). Regarding the media variables the highest relative number of articles from the selected categories were articles from the media category noise exposure with a peak in 2012. In contrary, only few articles were published referring to the media category "mistrust/trust in authority" and "increase in exposure".

Table 1 – Descriptives of the sample in the three study years 2011-2013.

	2011	2012	2013
Gender			
Female	53,5 %		
Male	46,5 %		
Socio-economic status			
M(*SD*)	13.8 (4.4)	14.0 (4.2)	14.2 (4.2)
Age (years)			
M(*SD*)	52.6 (14.6)		
Noise levels L_{den} (dB)			
M(*SD*)	51.8(6.2)	51.2(6.4)	50.5(6.5)
Min - Max	39.2 – 65.2	37.9 – 74.8	38.1 – 73.8
Noise levels L_{night}			
M(*SD*)	42.4(6.3)	41.8(6.0)	41.6(5.9)
Min - Max	35.0 - 56.7	35.0 - 65.4	35.0 - 64.2
Noise annoyance			
M(*SD*)	3.3(1.3)	3.4(1.3)	3.2(1.3)
Sleep disturbances			
M(*SD*)	2.3(1.3)	2.2(1.2)	2.2(1.2)
Media variables:			
Sound insulation			
M(*SD*)	1.6(0.2)	2.4(0.1)	1.5(0.2)
Protest			
M(*SD*)	3.7(0.2)	6.5(0.2)	4.5(0.4)
Night flight			
M(*SD*)	1.3(0.1)	4.6(0.8)	1.0(0.2)
Mistrust/Trust in Authorities			
M(*SD*)	0.2(0.02)	0.3(0.03)	0.2(0.1)
Noise exposure			
M(*SD*)	6.1(0.3)	9.1(0.3)	7.1(0.2)
Increase exposure			
M(*SD*)	1.1(0.04)	0.5(0.1)	0.4(0.1)
Flight path			
M(*SD*)	3.5(0.2)	1.7(0.1)	2.2(0.4)

N = number of participants, M = mean, SD = standard deviation, min = minimum, max = maximum.

Correlations between acoustic variables (L_{den} and L_{night}) and annoyance ratings ranged between $0.36 \leq r \leq 0.48$ ($p < .001$). Correlations between self-reported sleep disturbances and sound levels were similarly of moderate values with $0.31 \leq r \leq 0.41$ ($p < .001$). The correlations between media variables and response variables (annoyance or sleep disturbances) were low and mostly non-significantly associated. Due to higher intercorrelations between the individual media variables regression models were calculated separately for each media variable.

Generalized linear mixed regression models were calculated with aircraft noise annoyance as the dependent variable and media category variables as predictors. In addition, sound pressure levels (L_{den}, L_{night}) and the categorical variable study year (2011, 2012, 2013) were included as predictors. In total, eight separate regression models were calculated. Results are depicted in Table 2. For each model regression coefficients and standard errors are listed. Significant results are highlighted in red.

The sound level (L_{den} and L_{night}, respectively) was a significant predictor in all models. Subsequently we report the results that take into account media variables. Significant main effects were observed for media

categories “noise exposure” and “night-flight” (for the two models with the media category “night flight” M7, M8). The former effect needs to be interpreted with caution as the standard error has a rather broad distribution. Interaction effects were found for the year 2012 and the media category “sound insulation”, i.e. the media coverage on “sound insulation” predicted higher scores for noise annoyance in comparison with 2013. Another significant interaction effect was observed for the year 2011 and the media variable “flight path” predicting an elevating effect on noise annoyance. Interaction effects were further observed in both models with the media category “night flight”; prediction of a decrease in noise annoyance in the year 2011 in comparison with 2013 but an increase in sleep disturbance in 2011 in comparison to the year 2013.

Table 2 – Regression coefficients and standard errors (in brackets) of regression models for aircraft noise annoyance and self-reported sleep disturbance

	Media variables:							
	Model 1: sound insulation	Model 2: protest	Model 3: flight path	Model 4: mistrust	Model 5: noise exposure	Model 6: increase noise exposure	Model 7: night flight - Lden	Model 8: night flight – Lnight (outcome sleep disturbance)
Intercept	-1,31(0,34)	1,3(1,84)	-1,13(0,62)	-1,78(0,71)	-11,56(4,72)	-0,88(0,78)	-1,47(0,15)	-0,86(0,13)
log10Media_variable	-1,22(1,78)	-4,32(2,8)	-1,17(1,85)	-0,41(1,1)	11,85(5,58)	1,55(1,83)	2,18(1,07)	2,55(0,96)
Lden	0,09(0,01)	0,05(0)	0,09(0,01)	0,1(0,01)	0,27(0,09)	0,09(0,02)	0,09(0)	0,07(0)
Year 2011	-0,42(0,18)	-0,04(0,61)	-1,43(0,66)	-0,97(0,43)	2,66(1,45)	-1,37(0,88)	-0,68(0,22)	-0,8(0,18)
Year 2012	-0,61(0,58)	0,63(1,22)	0,06(0,35)	-0,07(0,29)	-0,94(1,74)	-0,13(0,29)	-1,61(0,75)	-1,43(0,66)
Year 2013	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]
Lden * log10Media_variable	0,01(0,03)	0,07(0,05)	0,02(0,04)	0(0,02)	-0,21(0,11)	-0,02(0,04)	-0,04(0,02)	-0,07(0,02)
Year2011 * Lden	0,01(0)	0,01(0,01)	0(0,01)	0,01(0)	-0,01(0,01)	0,02(0,02)	0,01(0)	0,02(0)
Year2012 * Lden	0(0,01)	-0,01(0,01)	0(0)	0(0)	0,02(0,01)	0(0)	0,03(0,01)	0,05(0,02)
Year2013 * Lden	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]
Year2011 * log10Media_variable	-0,29(0,52)	-1,47(0,97)	2,21(0,93)	-0,62(0,55)	-3,08(1,76)	2,72(1,46)	-1,15(0,54)	0,05(0,55)
Year2012 * log10Media_variable	2,49(1,23)	0,14(1,41)	-0,59(1,14)	-0,23(0,43)	-0,34(1,76)	-0,04(0,5)	0,32(0,27)	-0,28(0,26)
Year2013 * log10Media_variable	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]

a. Reference category, Media variables are logarithmized due to their right-skewedness.

4 Discussion

In this media analysis the impact of media coverage about different aircraft noise-related topics on responses to aircraft noise were investigated using longitudinal data from a socio-acoustic survey around Frankfurt Airport. Effects of several media categories on aircraft noise annoyance and sleep disturbance were observed. Influences of media coverage was examined for four groups of media reports: “sound insulation”, “flight path”, “noise exposure” and “night flight”. Media coverage about “sound insulation” predicted higher aircraft noise annoyance in 2012 in comparison to 2013, which might reflect an effect of the launch of a regional fund to compensate/support exposed residents with sound insulation. No effect of media articles about protests was observed which indicates that the reason of protests, in terms of the cause or topic, might be more important than just the occurrence of protests for the response on noise. In addition, no effect was observed for “mistrust”, which might be due to generally low occurrence of articles in this category. The media coverage about “flight path” had an elevating effect on noise annoyance for the year 2011 in comparison to 2013. Increased media coverage in 2011 could be a result of changes in the operational configurations in flight paths about six months before the opening of the new runway in preparation to the upcoming four-runway system. This might have triggered negative expectations about future noise distributions after the expansion. Media coverage about “noise exposure” predicted the highest scores although this result hast to be treated with caution as the standard error was very broad, indicating the effect to be imprecise. However, an effect of media articles about “aircraft noise exposure” on aircraft noise responses might reflect that the aircraft noise exposure might be related to worries about any harm for one’s health or negative effects for one’s living situation. In addition, the use of noise exposure as a single category might be too broad to properly represent the therein included effects. The media coverage about night flight predicted a decreasing effect on aircraft noise responses, in 2011 in comparison to 2013, for noise annoyance and sleep disturbance. Presumably, this is resulting from the night flight ban that was implemented in the scope of the airport expansion in 2011.

In general, a high number of articles about certain topics are assumed to be indicative of importance or actuality of a topic. However, one can argue whether public discourse is properly represented in the media. The current press review that was analysed represents only an extract of available articles. It is an approximation towards the number and kind of articles, a person is potentially exposed to. The possible media exposure further does not necessarily reflect a person’s exposure to the specific media articles. However, we can hypothesize based on a study by Bröer [10], that public discourse might resonate in private discourse via media coverage. Future studies should also take into account the value of the articles, i.e. if they report about negative, positive or neutral facts. Also, attention should be drawn to the potential impact of social media on noise responses. Social media was not analysed in this study, however, there is evidence of the important role of social media in the discourse in airport regions [19].

5 Conclusions

This media analysis found effects of aircraft noise-related media coverage on the manifestation of aircraft noise responses. This finding emphasizes that non-acoustic factors should be taken into account when investigating and addressing noise responses. It is not possible nor desired to influence media coverage but it should be kept in mind that any intervention or airport-related decision can be accompanied by media attention, i.e. spreading further through media and thus it is important to be transparent about those decisions in noise management. Change and improvement of the noise situation should result in positive media coverage. Therefore, transparent and honest communication should be established with any changes in noise management [20].

Acknowledgements

This study was done as part of the Aviation Noise Impact Management through Novel Approaches (ANIMA) project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769627.

References

[1] Benz, S.; Schreckenberg, D. Examination of the causal relationship between aircraft noise exposure, noise annoyance and diagnoses of depression using structural equation modelling. *Proceedings of the 23rd International Congress on Acoustics (ICA).* Aachen, Germany, September 09-13, 2019 (in CD-ROM).

[2] Gong, X.; Fenech, B.; Blackmore, C.; Gulliver, J.; Hansell, A. Association between noise annoyance and mental health outcomes – a systematic review. Proceedings of the 50th *Proceedings of the INTER-NOISE 2021, 50th International Congress and Exposition on Noise Control Engineering*, Washington (USA), August 1-5, 2021 (in CD-ROM).

[3] Baudin, C.; Lefèvre, M.; Babisch, W.; Cadum, E.; Champelovier, P.; Dimakopoulou, K.; Houthuijs, D.; Lambert, J.; Laumon, B.; Pershagen, G.; Stansfeld, S.; Velonaki, V.: Hansell, A.L.; Evrard, A-S. The role of aircraft noise annoyance and noise sensitivity in the association between aircraft noise levels and hypertension risk: Results of a pooled analysis from seven European countries. *Environmental Research*, Vol 191, 2020, pp 110179. DOI: 10.1016/j.envres.2020.110179

[4] Guski, R. Personal and social variables as co-determinants of noise annoyance. *Noise Health*, Vol 3, 1999, pp 45–56.

[5] Asensio, C.; Gasco, L.; de Arcas, G. A Review of Non-Acoustic Measures to Handle Community Response to Noise around Airports. *Curr Pollution Rep 3*, 2017, pp 230–244. https://doi.org/10.1007/s40726-017-0060-x

[6] Haubrich, J.; Hooper, P.; Rajé, F.; Burtea, N.E.; Radulescu, D.; Schreckenberg, D.; Flindell, I.; Hudson, R. ANIMA D2.4-Recommendations on Annoyance Mitigation and Implications for Communication and Engagement; European Commission: Brussels, Belgium, 2019.

[7] Bartels, S.; Richard, I.; Ohlenforst, B.; Jeram, S.; Kuhlmann, J.; Benz, S.; Hauptvogel, D.; Schreckenberg, D. Coping with aviation noise: Non-acoustic factors influencing annoyance and sleep disturbance from noise. In: Leylekian, L., Maximova, A., Covrig, A. (eds.) *Aviation Noise Impact Management: Technologies, Regulations, and Societal Well-being in Europe*. Springer, Berlin, Heidelberg (Germany), in print.

[8] Crichton, F.; Dodd, G.; Schmid, G.; Gamble, G.; Cundy, T.; Petrie, K. The power of positive and negative expectations to influence reported symptoms and mood during exposure to wind farm sound. *Health Psychology*, Vol 33 (12), 2014, pp 1588.

[9] Crichton, F.; Dodd, G.; Schmid, G.; Petrie, K. J. Framing sound: Using expectations to reduce environmental noise annoyance. *Environmental research*, Vol 142, 2015, pp 609-614.

[10] Bröer, C. Policy annoyance: How policies shape the experience of aircraft sound. *Aerlines*, Vol 37, 2007.

[11] Kroesen, M.; Bröer, C. Policy discourse, people's internal frames, and declared aircraft noise annoyance: An application of Q-methodology. *The Journal of the Acoustical Society of America*, Vol 126 (1), 2009, pp 195-207.

[12] Guski, R.; Klatte, M.; Moehler, U.; Müller, U.; zur Nieden, A.; Schreckenberg, D. NORAH (Noise Related Annoyance, Cognition, and Health): Research Questions, Designs, and Main Results. *Proceedings of the 22nd International Congress on Acoustics 2016*, Buenos Aires, Argentina, September 5-9, 2016, Paper No. ICA2016-157.

[13] Guski, R., Peschel, C., & Wothge, J. Begleitende Medien-Inhaltsanalyse (Accompanying media analysis). Ruhr-University Bochum. Bochum (Germany), 2014. Retrieved from https://norah-studie.de//de/publikationen.html?file=files/norah-studie.de/Downloads/NORAH_EB_Medienanalyse%20210719.pdf

[14] Schreckenberg, D.; Faulbaum, F.; Guski, R.; Ninke, L.; Peschel, C.; Spilski, J; Wothge, J. Wirkungen von Verkehrslärm auf die Belästigung und Lebensqualität. In Gemeinnützige Umwelthaus gGmbH (Hrsg.), NORAH (Noise related annoyance cognition and helath): Verkehrslärmwirkungen im Flughafenumfeld (Bd. 3). Kelsterbach (Germany), Umwelthaus gGmbH, 2015. Retrieved 27.07.2021. URL: https://www.norah-studie.de//de/publikationen.html?file=files/norah-studie.de/Downloads/NORAH_Bd3_M1_Endbericht_151031.pdf

[15] International Organization for Standardization ISO/TS 15666 (ISO/TS 15666:2003-02).*Acoustics – Assessment of noise annoyance by means of social and socio-acoustic surveys.* Geneva: ISO TC 43/SC.

[16] Fields, J., De Jong, R., Gjestland, T., Flindell, I., Job, R., Kurra, S., . . . Yano, T. Standardized general-purpose noise reaction questions for community noise surveys: Research and a recommendation. *Journal of Sound and Vibration*, Vol 242 (4), 2001, pp 641-679.

[17] Möhler, U.; Liepert, M.; Mühlbacher, M.; Beronius, A.; Nunberger, M.; Braunstein, G.; . . . Bartel, R. Erfassung der Verkehrsgeräuschexposition. NORAH: Verkehrslärmwirkungen im Flughafenumfeld. Kelsterbach (Germany)Gemeinnützige Umwelthaus gGmbH, 2015.

[18] Hauptvogel, D.; Richard, I.; Haubrich, J.; Kuhlmann, J.; Heyes, G.; Benz, S.; Hooper, P.; Bartels, S.; Schreckenberg, D.ANIMA deliverable D3.9 Engagement Guideline. (under review)

[19] Meddeb, I., Lavandier, C., & Kotzinos, D. (2019). Using Twitter Streams for Opinion Mining: a case study on Airport Noise. Paper presented at the International Workshop on Information Search, Integration, and Personalization.

[20] Heyes, G.; Hauptvogel, D.; Benz, S.; Schreckenberg, D.; Hooper, P.; Aalmoes, R. Engaging communities in the Hard Quest for Consensus. In: Leylekian, L., Maximova, A., Covrig, A. (eds.) *Aviation Noise Impact Management: Technologies, Regulations, and Societal Well-being in Europe*. Springer, Berlin, Heidelberg (Germany), in print.