inter.noise
HAMBURG 2016

Residents' expectancies of stress stimuli, behavioral outcome and behavioral control as a key to health inequities in the context of noise action planning: A conceptual model and its empirical translation

Natalie Riedel[1], Gabriele Bolte[2]

[1] Department of Social Epidemiology, Institute of Public Health and Nursing Research, Health Sciences Bremen, University of Bremen

ABSTRACT

Noise action planning according to the Environmental Noise Directive (END) requires residents' motivation and capability to participate in the process of selecting and localizing noise abatement and noise protection measures. However, population strategies whose effectiveness primarily rests on individual residents' agency are supposed to produce additional health inequities. We therefore present a conceptual model explaining unequal participation and health chances in relation to residential exposure to traffic noise. Drawing on four concepts (reformulated learned helplessness model, Model on household's Vulnerability to the local Environment, Cognitive Activation Theory of Stress, Reserve Capacity Model), we study a cognitive process involving stimulus, outcome, and control expectancies as predictors of civic engagement, generalized patterns, and health. Moreover, we discuss potential analytical strategies based on the special data structure resulting from an on-going epidemiological cohort study. We may use its annual follow-up procedure to administer a model-specific questionnaire to its participants. Thus, we are enabled to combine cross-sectional data from our questionnaire and the regular follow-up with longitudinal data from three waves. Further, we plan to contextualise individual-level associations by adding noise exposure as modelled by END noise maps and residential neighbourhood variables to our statistical equations.

Keywords: Community noise levels, Planning for noise control, zoning, land use and urban planning, Perceived noisiness, annoyance, 52.1, 52.9, 63.2

1. INTRODUCTION

In response to the enormous health burden of traffic-related noise in urban areas (1), the EU Environmental Noise Directive (END, 2002/49/EC) requires public environmental authorities to map environmental noise and to implement noise action plans for noise abatement. With its objective to protect and improve European populations' environmental health, noise action planning can be considered as a population-based prevention strategy (2). Correspondingly, noise action planning is assumed to yield a relatively homogeneous impact for all populations groups. However, noise action planning is bound to be highly selective in terms of contents, place and timing of actions given the high prevalence of elevated noise exposure levels in urban areas. Social inequalities in traffic exposures can augment as a side effect of interventions (3). Health inequities may exacerbate in this instance, for unfavorable living and health conditions are likely to concur and to enhance vulnerability to environmental (noise) exposures (4, 5). Distributional effects may come from procedural features of the policy cycle, even if based on the "objective" mapping of environmental noise. Without a binding standard for noise action values, noise action planning is more subject to the agency of those motivated to participate in the planning process than a matter of "objective" noise (health) assessment (6). At the same time, social epidemiological reasoning suggests that intervention strategies building on individuals' motivation and capacity to participate may magnify health inequities (7). Research in the field of environmental justice contends that a limited coping repertoire explains socio-political

[1] nriedel@uni-bremen.de
[2] gabriele.bolte@uni-bremen.de

vulnerability among residents in lower social positions. Inconsiderate of structural constraints and vulnerability differentials, noise action planning still expects residents to be active citizens.

2. CAPTURING COGNITIVE-EMOTIONAL DETERMINANTS OF CIVIC ENGAGEMENT IN RESPONSE TO TRAFFIC NOISE IN RESIDENTIAL AREAS

2.1 Noise-induced helplessness vs. institutional coping?

Against this END background, it is of utmost importance to know the cognitive-motivational determinants of residents' motivation and capacity to take interest in environmental quality of their residential environment and to be ready for civic engagement. To this end, we recur to the "Model on household's Vulnerability to the local Environment" (MOVE) developed only recently (9). At the interface of behavioral science, health psychology, and environmental urban planning, MOVE is conceived to explain residents' intention and actual performance of civil actions directed at the municipal authority in charge of environmental regulation, e.g. collecting signatures, joining or founding a local initiative. Thus, MOVE deals with residents' institutional coping as an active, problem-focused response to air and noise pollution. Based on the Theory of Planned Behavior (10, 11), MOVE describes cognitive-motivational predictors of institutional coping that reflect positive expectancies of coping outcomes (as captured by behavioral attitude and subjective norm) and self-efficacy (as an important aspect of perceived behavioral control).

However, instead of active engagement, environmental psychological research referring to the learned helplessness model rather suggest a higher probability of passivity and social withdrawal because of uncontrollable environmental exposures like air and noise pollution (12-14). Traffic-related noise has been described as an ambient or environmental stressor that is chronic and intractable (15). It seems plausible to assume that these two objective characteristics give rise to a chronic, "universal" helplessness facilitating socio-political disengagement. If intractability implies that traffic-related noise cannot be removed by any individual's "isolated effort" (ibid. p. 363) and will not cease due to its chronicity, residents may learn they (and no one else in the group of relevant others, e.g. neighbors, see also 16) have no control over their environment. Unpredictability of noise peaks makes adjustment even more difficult (17). Such a characterization of uncontrollability may result in universal, communal helplessness shared by noise-exposed residents, which, in turn, may bring about a more general passivity and disinterest in neighborhood and community issues. In this vein, communication disturbance, withdrawal from the environment outside the dwelling, diminished place attachment and social support in the neighborhood have been described as "social costs" of high traffic loads in the residential environment (18). However, the affective value may moderate the psychological stress reaction as expressed by noise annoyance (19, 20 in conjunction with 16).

Strangely, environmental psychological research has paid little attention to cognitive-motivational determinants of residents' capacity to claim rights for environmental health in the community context despite recognizing the relevance of perceived control over noise exposure and coping strategies for noise annoyance, well-being, and health (19, 21-23). Rather, residents' distrust in regulatory authorities has been considered as a determinant of controllability perceptions and coping capacity preceding noise annoyance (19, 22) or as one psychological determinant of noise annoyance among others (24-25). Studies on learned helplessness have focused on changes to task performance and persistence, employing outcome measures such as the proportion of tasks correctly solved, time or number of attempts until withdrawal from unsolvable tasks, or time until coming up with an effective solution after suffering failure from unsolvable tasks (see (13) for an overview).

Therefore, we should make an effort to understand how noise-specific helplessness may spill over to affect residents' expectancies of MOVE institutional coping. We therefore introduce a cognitive learning perspective as described by the Cognitive Activation Theory of Stress (CATS, 26, 27). Using CATS, we learn more about the relationship between generalized helplessness and residents' participation and health chances. Residents' expectancies of stress stimuli, behavioral outcome and behavioral control (self-efficacy) appear as key variables in this respect. While delineating our new model, we understand noise annoyance as emotional stress response to perceived uncontrollable noise exposure that contributes to sustained physiological activation.

2.2 The role of resources for civic engagement and health inequities

MOVE suggests that differentials in institutional coping between population groups are explained by unequal access to resources. The role of resources is made explicit by the Conservation of

Resources (COR) Theory (28), an established stress theory in health psychology. In brief, COR theory purports that stress results from the feared and suffered loss of resources an individual needs to maintain for her or his well-being or from vain resource investment, as an individual tries to prevent resource loss. Whilst studied as a typical outcome of stress-related processes in epidemiology and psychology, COR theory regards (environmental) health as a resource vital to an individual's development and agency. Consequently, perceived behavioral control as a predictor of institutional coping depends on the availability and conversation of resources.

To embed our model in social epidemiological research on health inequities, we additionally draw on the Reserve Capacity Model (29, 30) underscoring the resource perspective of MOVE. In principle, the pathways to health inequalities in this model are well known: Social differences in chronic or repeated stress experienced in different contexts (e.g. home, work, and neighborhood environments) cause inequalities in stress reactivity, in stress-related physiological changes, and, finally, in morbidity and mortality (we may call this "direct pathway"). The notion of stress as a "threat of or actual loss of resources" is burrowed from COR theory. Another pathway emphasizes the emotions (e.g. anger, frustration, anxiety; we may add noise annoyance here) and cognitions individuals develop in stress response. These emotions and cognitions are transformed into pathophysiology and mal-adaptive behavior as predecessors of mortality and morbidity. We apply this cognitive-emotional pathway to our research interest. In reference to COR theory, the reserve capacity model states that a cumulative lack of resources is responsible for enhanced stress reactivity among individuals of lower social positions. Low social positions lead individuals in contexts posing high demands to be met while making it difficult for them to restore and to augment their resources. An increasing disparity between resources spent and resources gained erodes an individual's reserve capacity, that is her or his resource aggregate. In the emotional-cognitive pathway to health inequalities, the reserve capacity is located between stress as defined by resource loss and cognitive-emotional differentials. A diminished reserve capacity partly mediates and/or moderates negative cognitions and emotions, mal-adaptive behaviors and pathophysiological processes.

Our model highlights cognitive-motivational processes related to the ambient stressor "traffic-related noise" (indirect pathway to health). Yet, the objective traffic-related noise exposure is the cause for planners to deal with noise abatement, and the direct-physiological path from noise levels to chronic diseases must not be neglected. Our model describes three (bio-)psychosocial links between cognition and motivation on the one hand and physiological changes on the other hand: through generalized expectancies of stress stimuli, behavioral outcomes and behavioral control (self-efficacy), and, finally, noise annoyance.

3. EMPIRICAL TRANSLATION

We plan to test our model using data from an on-going epidemiological cohort study in three major cities of the Ruhr Area, a German region characterised by enormous economic restructuring, huge differences in environmental quality, and socio-spatial polarisation. To fathom health inequities, we intend to run the model in subgroups defined by indicators of social position, age and gender, and health (e.g. sleep disturbances). We may use the annual follow-up of this epidemiological study to administer a model-specific questionnaire to its participants. Thus, we can combine cross-sectional data from our questionnaire and the regular follow-up with longitudinal data from three waves measured at approximately equal intervals, but different time points in the past 15 years. Further, we will contextualize individual-level associations by adding noise exposure as modelled by END noise maps and residential neighborhood variables to our structural and regression equations.

4. CONCLUSIONS

With the second generation of noise action plans having been set up in larger cities, the political and administrative interest in evaluating their effectiveness presently appears to be high. Evaluation practice is mainly concerned with the efficiency of noise reduction measures and formal instructions do not demand to consider health equity. Our model suggests that residents' expectancies of stress stimuli, behavioral outcomes and behavioral control can explain inequities in political participation and health chances.

ACKNOWLEDGEMENTS

We are grateful to Irene van Kamp for her valuable support of this work.

NR is currently funded for a research project within the framework of the Institutional Strategy of the University of Bremen. This strategy is financed by the German Federal Government's and the Federal States' 'Excellence Initiative'.

REFERENCES

1. World Health Organization Regional Office for Europe. Burden of disease from environmental noise. Quantification of healthy life years lost in Europe; 2011 [04 May 2016]; http://www.who.int/quantifying_ehimpacts/publications/e94888/en/.
2. Rose G. Sick Individuals and Sick Populations. Int J Epidemiol. 1985; 14(1):32-38.
3. Kruize H. [Einfluss eines neuen Verkehrsplans (VCP) auf Personen mit unterschiedlich hohem Einkommen: Erfahrungen aus der Stadt Den Haag in den Niederlanden]. In: [5]. p. 419-420.
4. Kruize H. On environmental equity. Exploring the distribution of environmental quality among socioeconomic categories in the Netherlands. Utrecht, The Netherlands: Koninklijk Nederlands Aardrijkskundig Genootschap.
5. Bolte G, Bunge C, Hornberg C, Köckler K, Mielck A, editors. [Umweltgerechtigkeit. Chancengleichheit bei Umwelt und Gesundheit: Konzepte, Datenlage und Handlungsperspektiven]. 1st ed. Bern: Hans Huber; 2012.
6. Schulze-Fielitz H. [Brauchen wir eine Verordnung zur Lärmaktionsplanung?]. NuR. 2009; 31(10):687-693.
7. McLaren L, McIntyre L, Kirkpatrick S. Rose's population strategy of prevention need not increase social inequalities in health. Int J Epidemiol. 2010; 39(2): 372-377
8. Köckler H, Hornberg C. [Vulnerabilität als Erklärungsmodell einer sozial differenzierten De-batte um Risiken und Chancen im Kontext von Umweltgerechtigkeit]. In: [5], p. 73-83.
9. Köckler H. [Vulnerabilität von Haushalten gegenüber ihrer lokalen Umweltgute. Eine Analyse aus planerischer Perspektive vor dem Hintergrund umweltbezogener Gerechtigkeit]. In press.
10. Ajzen I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. J Applied Social Psychology 2002; *32*: 665-683.
11. Ajzen I. The theory of planned behavior. In: Lange PAM, Kruglanski AW, Higgins ET, editors. 2012. Handbook of theories of social psychology. Vol. 1. London, UK: Sage; 2012. p. 438-459.
12. Evans GW. 2001. Environmental Stress and Health. In: Baum A, Revenson TA, Singer JE, editors. Handbook of Health Psychology. Nahwah, NJ: Lawrence Erlbaum Associates Inc; 2001. p 365-385.
13. Evans GW, Stecker R. Motivational consequences of environmental stress. J Environ Psychol. 2004; 24,143-165.
14. Evans GW, Cohen S. Environmental Stress. In: Spielberger CD, editor. Encyclopedia of Applied Psychology. Oxford; Boston, Elsevier Academic Press; 2004. p. 815-824.
15. Campbell, JM. Ambient Stressors. In: Environment and Behavior.1983; 15(3): 355-380.
16. Abramson LY, Seligman MEP, Teasdale JD. Learned Helplessness in Humans: Critique and Reformulation. J Abnorm Psychol. 1978; 87 (1), 49-74.
17. Job RFS. The influence of subjective reactions to noise on health effects of the noise. Environmental International 1996; 22 (1), 93-104.
18. Flade A. [Die sozialen Kosten des Verkehrs]. In: Schöller O, editor. [Handbuch Verkehrspolitik]. Wiesbaden: VS Verlag für Sozialwissenschaften; 2007. p. 490-509.
19. Stallen PM. A theoretical framework for environmental noise annoyance. Noise Health 1999;1:69-79.
20. Klæboe R. Noise and health - Annoyance and Interference. In: Nriagu JO, editor. Encyclopedia of environmental health, Vol. 3. Burlington, MA: Elsevier; 2011. p. 152-163.
21. van Kamp I. Coping with noise and its health consequences. Groningen, The Netherlands: The University of Groningen 1990.
22. Kroesen M, Molin EJE, van Wee B. Testing a theory of aircraft noise annoyance: A structural equation analysis. J Acoust Soc Am 2008;123(6):4250-4260.
23. Schreckenberg D, Meis M, Kahl C, Peschel C, Eikmann T. Aircraft Noise and Quality of Life around Frankfurt Airport. Int J Env Res Public Health. 2010; (7): 3382-3405.

24. Guski R. Personal and social variables as co-determinants of noise annoyance. Noise Health 1999; 1(3):45-56.
25. Kroesen M, Molin EJ, Wee Bv. Determining the direction of causality between psychological factors and aircraft noise annoyance. Noise Health 2010;12:17-25.
26. Ursin H, Eriksen HR. The cognitive activation theory of stress. Psychoneuroendocrinology. 2004; 29(5):567-92.
27. Ursin H, Eriksen HR. Cognitive activation theory of stress (CATS). Neurosci Biobehav Rev. 2010; 34(6): 877-81.
28. Hobfoll SE, Jackson AP. Conservation of Resources in Community Intervention. Am J Community Psychol. 1991; (1), 111-121.
29. Gallo LC, Matthews KA. Understanding the Association Between Socioeconomic Status and Physical Health: Do Negative Emotions Play a Role? Psychological Bulletin. 2003; 129(1): 10-51.
30. Matthews KA, Gallo LC, Taylor SE. Are psychosocial factors mediators of socioeconomic status and health connections? A progress report and blueprint for the future. Ann NY Acad Sci. 2010; 1186: 146-47.