NOISE ANNOYANCE AND COPING: A SOFT ANALYSIS

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Introduction Although noise annoyance can reasonably well be correlated to exposure when large populations are considered, predicting the reaction of an individual or small group to noise exposure remains difficult. In literature, reports of small but significant correlation with several social, environmental, and other context factors can be found. In (Botteldooren et al, 2001) many of these potential interactions were gathered and a fuzzy rule based prediction model was proposed to include a large number of them. This paper focuses on one particularly interesting effect: the bi-directional interaction between noise annoyance and coping (Fields 1986, Lercher 1996, Lercher 1998, Pulles 1990). In contrast to earlier attempts to model this interaction, it is recognized here that both annoyance and coping are fuzzy concepts by nature and therefore traditional crisp models are bound to fail to predict the interaction for a small population. The whole concept of modeling should be viewed in a more soft, human-like perspective.

Methods The analysis presented in this paper is based on a survey involving approximately 3000 inhabitants of Flanders, Belgium, not particularly selected to be exposed to high noise levels. The questionnaire included several noise and odor-related questions as well as a large number of context questions. The noise annoyance question was in accordance with (Fields 2001) and used a five point categorical scale. Coping was characterized by asking respondents whether they thought about complaining, complained once, complained several times, thought about moving, contacted a lawyer, joined an action group, spoke to those responsible for the noise, more carefully close doors and windows because of the noise, made changes to the their house.

The first step involved clustering the coping questions. Traditional clustering and principal component analyses were supplemented by fuzzy clustering and self-organized mapping based on Kohonen neural network. Additionally, fuzzy clusters identified as social, active, and political coping are constructed manually based on expert knowledge.

Exposure to noise is the primary trigger for coping. The condition is however not sufficient. Personal and situational factors may also determine the type and intensity of coping. The fuzzy model assumes that noise creates the possibility that a person is coping, but does not predict the act itself. This possibility defines a fuzzy set in the coping universe U_C.

In order to discover whether a stable personal factor could be identified that allows reducing the vagueness in this relation, coping with noise annoyance and coping with annoyance by odor are compared. This is done by identifying two categories of people on the basis of their reaction to noise: *copers* and *non-copers*, using the fuzzy rules

IF *noise annoyance* is *high or extreme* AND *coping* is *some* THEN *personal factor* is *coper*
IF *noise annoyance* is *high or extreme* AND *coping* is *none* THEN *personal factor* is *non-coper*.

In other situations the *personal factor* remains *unknown*. Based on this additional factor, coping with annoyance caused by odor is refined.

Coping was shown to reduce the increase of blood pressure due to exposure to noise (Lercher,1998). A similar effect was not shown for annoyance. In fact, unsuccesfull coping may increase annoyance as well. These small effects are blurred by the uncertainty on the strong relation between noise annoyance and coping. Therefore a question on perceived change

in noise annoyance over the past years is used to analyse them using fuzzy linguistic rules to represent the vague relation.

Results Figure 1 shows the vague relation between annoyance and coping where all coping variables are grouped to a one-dimensional universe. Figure 2 gives the possibility for reporting a change in noise annoyance because of coping for different categories of noise annoyance. It is obtained by chaining fuzzy rules that relate annoyance to coping with those that relate coping to change in annoyance. It is a typical example of how to use the fuzzy knowledge to infere particular results.

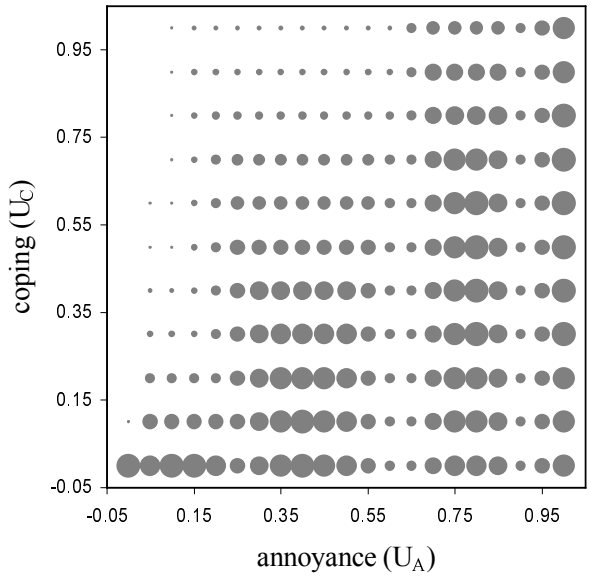

Figure 1. Vague relation between annoyance and coping (the size of the dots is proportional to the possibility)

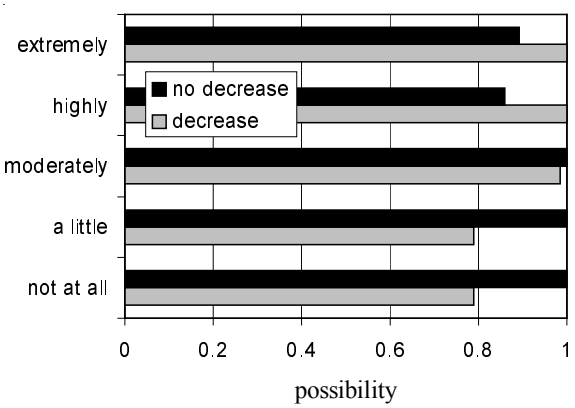

Figure 2. Possibility for reporting a decrease or no decrease in noise annoyance because of coping as a function of reported noise annoyance

Discussion The relation between noise annoyance and coping was analized in a new, soft way. This allowed identifying clusters of coping activities (not shown in this abstract). The effect of annoyance on coping intensity is described as creating the possibility for coping. Adding a personality factor, *coper,* can refine this possibility distribution. This factor seems common for coping with noise and odor. The effect of coping on annoyance change reveals two possible trends. We illustrate how the vague relations can be used, by investigating the possibility for reporting decreased annoyance due to coping.

Keywords: noise annoyance, coping, soft computing, fuzzy sets

References

Botteldooren D., Verkeyn A., Lercher P. (2002), *Noise and Health* **4** (15), pp. 27-44

Fields J.M., Hall F.L. (1986), *Transportation noise, Chapter 3,* edited by Nelson P.M. (Butterworth, London, 1986).

Fields J. M., R. G. De Jong, T. Gjestland, I. H. Flindell, R. F. S. Job, S. Kurra, P. Lercher, M. Vallet, T. Yano, R. Guski, U. Felscher-Suhr, and R. Schumer (2001), *Journal of Sound and Vibration* **242**(4), pp. 641-679.

Lercher P., Kofler W. (1996), *Sci. Tot. Environ.* **189/190**, pp. 85-89.

Lercher P. (1998), *Advances in Noise Series. Vol. I: Biological Effects* edited by D. Prasher & L. Luxon, (Whurr Publishers, London, 1998) pp 328-335.

Pulles, T., Biesiot, W., and Stewart, R. (1990), *Noise as a Public Health Problem, Vol. 4*, Berglund, B. and Lindvall, T., (eds.) Swedish Council for Building Research, Stockholm, pp. 337-348.