NEW AIRCRAFT NOISE IN LIVING AREAS - INTRODUCTION OF THE LOCAL SOUNDSCAPE MODEL

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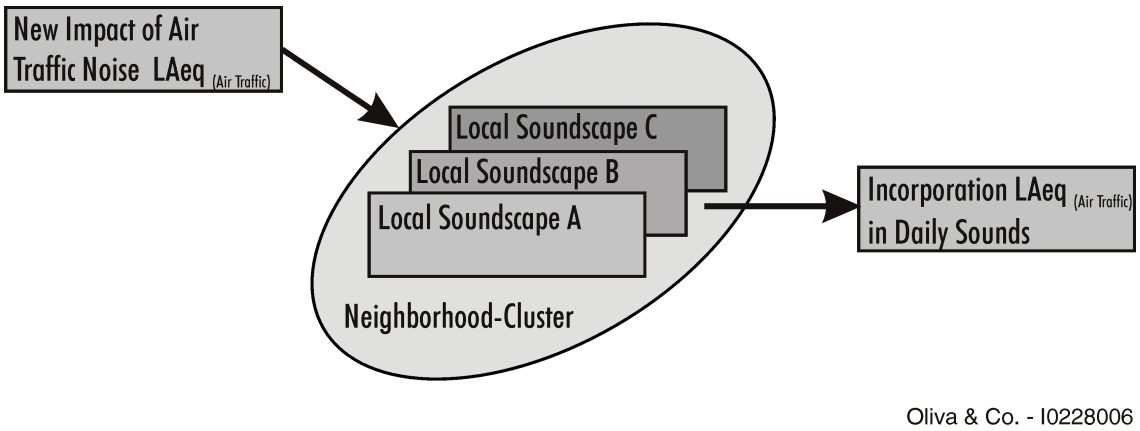
Introduction It is well known that the impact of aircraft noise has a direct correlation with the perceived annoyance [1, 2, and 3]. Although many investigations on the basis of the dose-response concept in the noise research have been made, the fact of newly by aircraft noise impacted living areas has rarely been analyzed in field research systematically. Furthermore, results from existing noise researches are reporting between the aircraft noise impact and the perceived annoyance an explained variance on the subject of thirty percent [4]. In the field of newly by aircraft noise impacted living areas not only special consideration has to be given to the here mentioned correlation, but also to the rise of the local existing daily sounds.

Problem The rushed criticism on the dose-response concept did put the base of the noise rating technique in the shade, for some it became evident that the equivalent sound level (LAeq) would treat the perceived annoyance only as a function of decibel. Other research results introduced intervening variables (e.g. getting used to noise, fear of health damage, trust in responsible administration, period of living and satisfaction with living area) in order to differentiate the dose-response concept, and some enhancement of the explained variance has been achieved [5, 6, 7, 8]. This result conforms to the noise research, because evidentially the intervening variables are not simply enforcing or diminishing a correlation, especially since the intervening variables are suppressing or masking effects in the dose-response correlation.
The current noise research emphasizes the introduction of soundscape in view of influencing the perceived annoyance and disturbance by specific noise sources [9, 13]. Other results report of the supportive acoustic environment in order to find attributes for expectation in different listening environments [10]. Building on recent extensions of this part of the noise research, this investigation describes a local soundscape model perspective on the effect of the perceived annoyance due to new aircraft noise impact in residential areas (Fig. 1).
I examine the local sounds of neighborhood characteristics using a multilevel approach to annoyance outcomes, providing an opportunity to disentangle the new impact of aircraft noise and local sounds effects. The analyses employ data from the Swiss Aircraft Noise Study 2000. This empirical data set offers an opportunity to investigate the contribution of new aircraft noise impacts to individual differences in annoyance status.

Figure 1: Local Soundscape Model



The application of the local soundscape model focuses on the question, whether the new and additional impact by aircraft noise will be incorporated in the local sounds of residential areas – or whether this new aircraft noise will become a separate criterion for the assessment for a specific living area and its estimation for the quality of living. Besides the here introduced question, the local soundscape model encourages the following research questions.

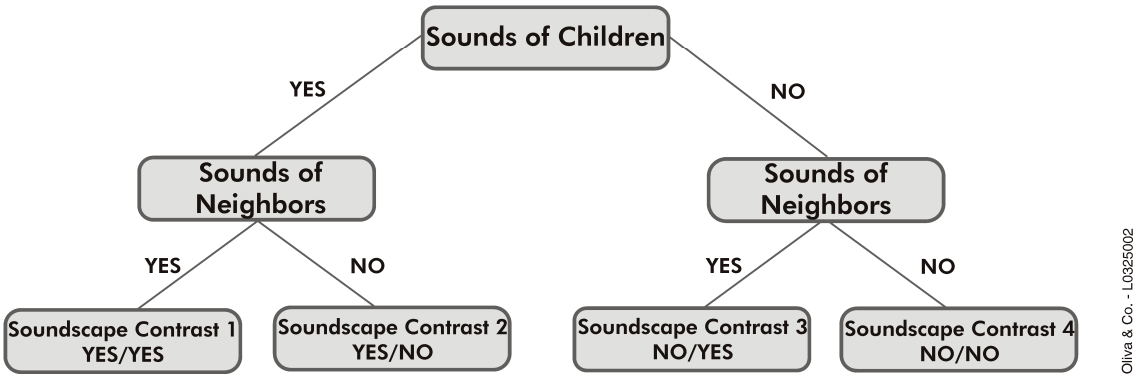
1. What is the contribution of each local soundscape in the specific evaluation of the perceived annoyance in a newly impacted aircraft noise living area?
2. What effects of the local soundscape model can be expected?
3. Do individuals differ in the perceived annoyance by new aircraft noise if the local soundscape model is assumed?

Sample Testing the local soundscape model, I choose a specific method of sampling, the cluster sampling. In this case a cluster is defined as a neighborhood context [16, 17]. In each cluster 40 members at or above the age of 18, having an equal distribution of gender and age were picked randomly to accomplish certain allocation for the key variables such as number of respondents, homogeneity of neighborhood contexts etc. Altogether the data set contains information on 828 respondents in 2000 (Swiss Aircraft Noise Study 2000). This information was raised in face-to-face interviews by a Gallup-Member agency on the basis of a standardized questionnaire.
The method of multi-stage cluster sampling is for two reasons preferable. 1st The lower level units (person) are already part of the higher level units' sampled (neighborhood). Not only is efficiency in estimation achieved, but a cost reduction during data collection. 2nd The multi-stage cluster sampling is the method of the social analysis on different and to each other related system levels. Developing comparative and relational properties, on each stage a new set of units on different levels is sampled. These properties are transmitted to the level as contextual properties (e.g. cluster position within its rural-urban differentiations, size of community) [11]. Correspondingly, lower level units are inspected for the properties of the units' distribution in order to transmit this information to units at the level above as analytical and structural properties (e.g. daily sounds in neighborhood contexts). Regardless whether researchers take a purposive or probability sample, the multi-stage cluster sampling method implies the decision to take the whole universe at the very last level [12]. A further benefit of the multi-stage cluster

sampling method is acknowledged with the extension of the pure econometric models of choice by relevant sociological indicators.
The acoustical measure, the equivalent sound level in decibel A over sixteen hours ($LAeq_{16hrs}$), was modeled with the integrated noise model INM version 6.0c [15]. The current and published standard departure and arrival routes were programmed with respect to the actual composition of aircraft types and its number of movements on that time at Zurich airport. The validation of this noise simulation has been carried out with cockpit data from several different types of aircrafts [14].

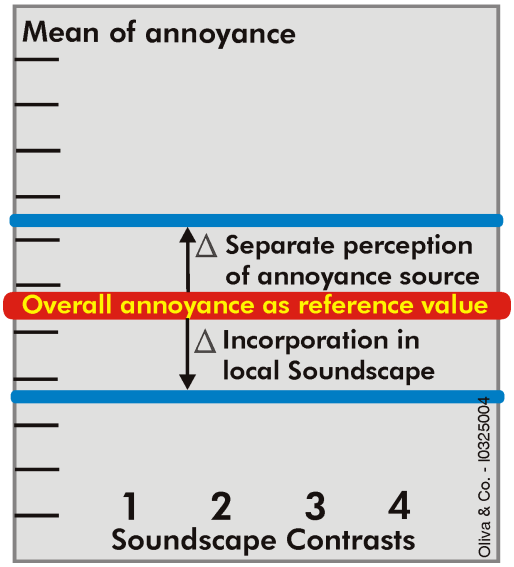
Experiment The here introduced experiment is build on a sub-sample of the discussed cluster sample only regarding those living areas, which were newly impacted by aircraft noise (N=409). This sub-sample is supplementary differentiated in a high and low aircraft noise impact level and is significantly under control of the means comparisons ($F=20.7008$; $p<.0001$). It is further assumed that each living area has its own and specific local soundscape. A local soundscape is defined as the representation of objects and processes, which are based on a direct association with the corresponding sound signals. Each person was interviewed for the local soundscapes like sounds of cars, neighbors, children, and playgrounds etc. Hence, the data set delivers the basis for the various combinations of these local sounds building contrasts of soundscapes.

Figure 2: Soundscape Contrasts Scheme



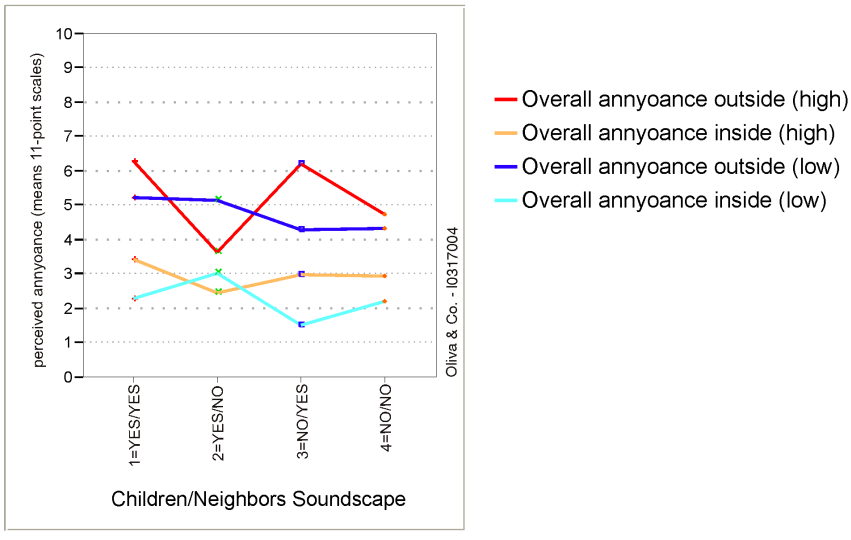
Many soundscapes contrasts are possible, yet one example is given in Fig. 2. Individuals' state that they perceive both of these sounds in their living room, or either of these sounds, respectively none of these sound contrasts. These soundscape contrasts – in this case the sounds of children and neighbors – are analyzed referring to the value of the overall annoyance by comparisons of the means (Fig. 3).
The introduction of several different indicators simultaneously seems to be the clear benefit of the soundscape model. For the interpretation of the results it is assumed that annoyance means due to the new aircraft noise impact, which are *below* of the overall annoyance means, will be incorporated in the daily, local sounds of a residential area. Means *above* this reference value show a separate perception of the annoyance source. Hence, different statements about the effects of sounds and the judgment about the perceived annoyance in specific situations of the noise impact are expected.

Figure 3: Incorporation of aircraft noise annoyance in local soundscapes



Results I first examine the hypothesis that the new impact of aircraft noise on the perceived overall annoyance does vary across residential areas (high and low), in- and outside of the house, and in function of the corresponding soundscape contrasts (Fig. 4). As a residential area disadvantage increases, namely a high aircraft noise impact level, the effect of the corresponding local soundscape appears to increase on the means of the overall annoyance scale, regardless the spatial situation of an individual (in-/outside). In this case, only the soundscape contrast two deviates from the observed pattern, individuals seem to tolerate the sounds of children more than the sounds of neighbors.

Fig. 4: Means Comparisons Children/Neighbors Soundscape and overall annyoance in- and outside
(high and low aircraft noise impact levels)



I next consider new aircraft noise impacted areas separately (high and low impact levels) with the same soundscape contrasts (children/neighbors) on the association between the overall annoyance, and the annoyance by street traffic noise, and air traffic noise inside the house, ex-

amining the hypothesis that the daily local sounds yield greater values to the overall annoyance and that the effect of the advantage of the living area (low impact level) is, in part, due to the incorporation of the new impact source in the local soundscape (Fig. 5). As this advantage decreases (high impact level), the annoyance caused by the new aircraft noise impact becomes an additional, and separate dimension of perception (Fig. 6).

Fig. 5: Means Comparisons Children/Neighbors Soundscape
and annyoance by street, air traffic noise and overall annyoance
(low aircraft noise impact level)

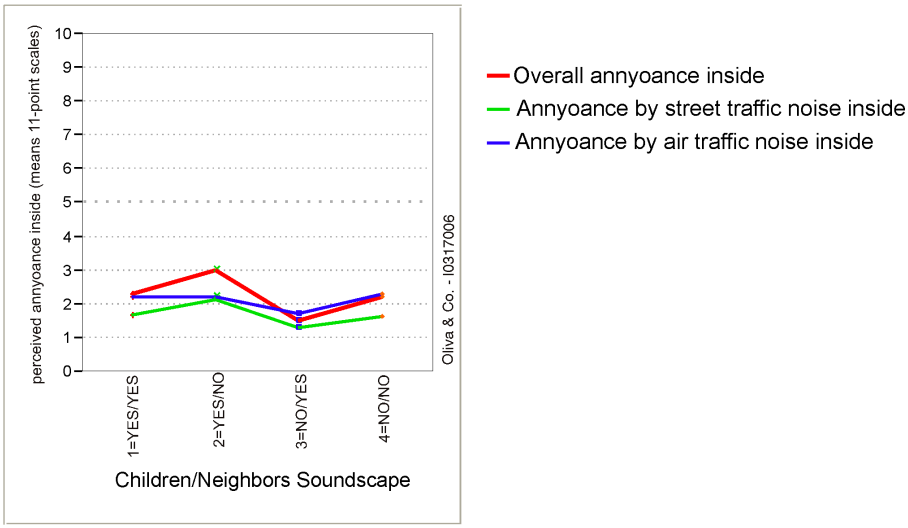
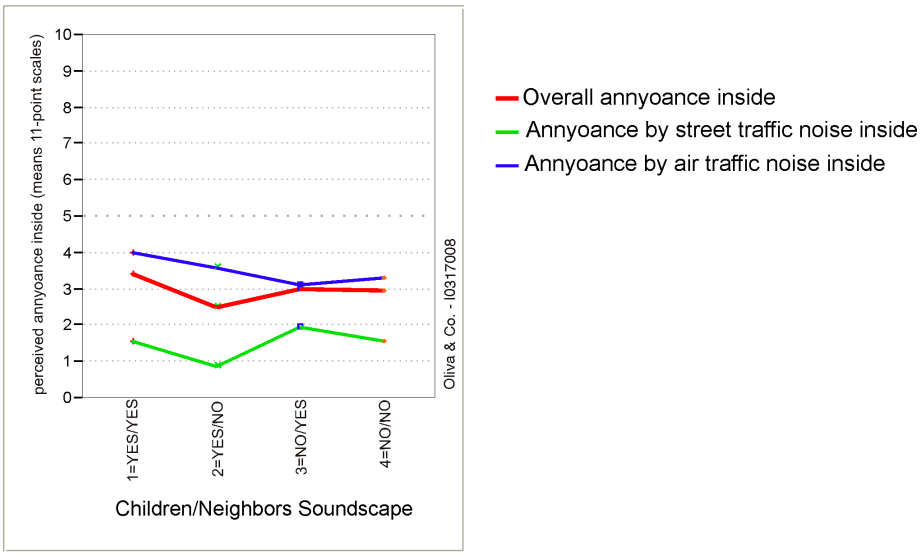


Fig. 6: Means Comparisons Children/Neighbors Soundscape
and annyoance by street, air traffic noise and overall annyoance
(high aircraft noise impact level)



Discussion Indeed, adding local soundscapes contrasts as additional indicators to explain the annoyance caused by a new noise source, significant differences in the evaluation of annoyance can be found. Moreover, the introduction of the local soundscape model shows its efficacy measures not only in- and outside the house, but especially in low and high impacted residential areas. In a disadvantaged living area the new impact by aircraft noise will reorganize the cognitive perception of the local soundscape.

Keywords: New Aircraft Noise Impact, Soundscapes-Model, Annoyance Evaluation, Neighborhood Context

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