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Soundscape Studies and Auditory Cognition[1]

My fellow ethnomusicologists have frequently bothered me with their question if soundscape research really *can* be filed under a discipline which is mainly known for its interest in music in different cultures. My somewhat cheeky standard answer has been "Not necessarily but you can file Ethnomusicology under Soundscape Studies".

The subject is a matter of definitions and connotations. Multidisciplinary soundscape studies is difficult to assign to any conventional discipline: in Canada it is placed under Communications, the French have united it with Architecture and the Finns with Musicology. Musicologist Henrik Karlsson (2000: 12) counts that at least 20 disciplines have been involved in studies of acoustic environments. Among other disciplines it has been a subject of human geography, philosophy, psychology, acoustics, and political science. Cultural studies have contributed articles for instance in dealing with the questions of sound and power. The pros and cons of studies of acoustic environment are found in this multidisciplinarity: on the one hand it allows a combination of different scientific approaches under the same comprehensive title but on the other hand there are no clear boundaries to "New Age philosophies". Meanings and connotations embedded to term *acoustic ecology* which is closely related to soundscape research might also be the reason why Karlsson (2000: 13) is not too enthusiastic about it.

I shall shed some light to the matter by introducing predominantly empirical soundscape research. Different studies introduced in the first part of the paper extend from the 1920's Finland to the French studies of sonic environment in the year 2000. The survey is by no means exhaustive: it is focused on Canadian and European studies although it must be noted that soundscape research has also gained popularity in Australia and in Japan.

I will also deal with different approaches of cognitive studies and if such approaches could be applied to the study of sonic environments. Cognitive musicology,

for instance, has been interested in processes that take place in an individual's mind while interacting with music: musicologists have applied computer-based modelling whereas ethnomusicologists rely on qualitative methods like observation and interviews (Moisala 1993: 50). Some aspects of cognitive ethnomusicology are presented in brief as well as a few principles of auditory cognition.

In addition, I will introduce a case study which I carried out in the Swedish village of Skruv in autumn 2000. The study is a combination of ethnographic observation and listening tests which consisted of villagers recognising the sound samples recorded from their living environment. It must be noted, however, that the study is only explorative; it does not propose a method.

Since the contradiction between context-oriented field studies and auditory cognition studies accomplished in laboratories is probably unresolved, I do not seek to solve that either. I am concentrating mainly on interfaces between different cognitive- related disciplines and their possible future contributions to soundscape studies.

Acoustic Environment

Geographer Johannes Gabriel Granö (1930) was the first to pay systematic attention to sonic environment when he studied the island of Valosaari in eastern Finland in late the 1920's. Granö's starting point for his concept of *Pure Geography* was the environment as perceived by human senses contrary to other geographers at that time. This would also enable the cognitive phase of geographical research to be taken into consideration. Granö drew a distinction between immediate and distant environments which he called *proximity* and *landscape*[2] respectively, although it must be noted that terms are not based on the researcher's own experience but physiologists' empirical results. (Granö & Paasi 1997: xvii). Auditory phenomena are considered "highly relevant factors in proximity" and because hearing provides more temporal information when compared to other senses, there is a good reason to call it the *sense of time*. To quote Granö (1997: 125–126; emphasis in original): "Things that occur are of a greater significance in the auditory complex, of *field of hearing*, than things that exist, for everything that is heard is an occurrence: tones, sounds, noises, harmonies, and discords".

Granö's Finnish terminology was influenced by the linguistic preferences/trends in the science of his time. Because of the relatively short history of Finnish as a literary language, scientists considered that it was important to invent original Finnish terms instead of using words borrowed from Latin. (Kurkela 2001.) Pure Geography, too, was influenced by this policy. It caused Granö to develop a terminology which is almost poetic in its eloquence and not just scientific, but also an aesthetic pleasure to read.

Granö's work was later continued and his methods refined by his compatriot Birger Ohlson (1976). He deals with changes in the sonic environment of rural Finland. Ohlson calls the sonic environment of a sound source a *sound field*. The sonic environment of the receiver of the sound is called *sonic landscape*, *anthropocentric sonic landscape* or *soundscape*. Drawing on Granö's visual-based division Ohlson remarks that the limit between immediate and distant soundscape is not clearly defined because of weather and ground conditions. Therefore he suggests that the term *transitional zone* should be introduced into the study of anthropocentric sonic landscape. Ohlson included sound measurements and analysis, atmospheric effects and ground attenuation to his study. As a result he noticed that the masking noise of agricultural machinery, chain saws and tractors have become a central sound in the country alongside more traditional church bells, which can still be heard in many villages. He also suggests that the recreational environment should provide the absence of disturbing noise to counterbalance the city life of urban dwellers.

In a previous account, Ohlson (1975) writes about noise and sounds in a city. According to him traffic can be considered as a "scenery of background sound" that masks and drowns less prominent sounds. Places of different "sonic identity" were also observed from different parts of the city, e.g. in harbour area, railway station and in school yard. Ohlson thus paid attention to different sonic identities within one city but he included only areas of high sound levels. The background noise of regional sounds was penetrated only by a few sounds from distant sources like thunder or aircraft noise. On the other hand when a pedestrian street was introduced in the centre of Helsinki, Finland in 1970 its renewed human soundscape was soon covered with piped music.

Ohlson´s work was influenced by a psychologist Michael Southworth (1969) who studied the urban sonic environment of Boston. His interests were the perceived variety and character of city sounds and what influence sounds have on perception of the visible city. Subjects participating in the study wore either blindfolds, ear protectors or nothing and were thus called auditory subjects, visual subjects and visual-auditory subjects respectively. By separating different perceptions from each other the interaction between vision and audition was facilitated. According to Southworth's research the "visual experience of cities is closely related to the sounds that accompany it" and that design of a soundscape could make a city more informative and less stressful to its inhabitants.

Despite its "beautification" suggestions, Southworth's research is significant because it is probably the first study that takes the perceptual and cognitive aspect into consideration instead of concentrating solely on objective measurements (Truax 2001: 73). According to the study the evaluative judgements of the sonic environment are also dependent upon the meaning of the sounds like the information of the sound and where the sound occurred (Ballas & Howard 1987). The sonic environments of cities also confirm Granö's notions stated above about hearing and its connection to tempo-

ral information: one of the psychological effects of sudden deafness is that a person is less conscious of the passing of time (Knapp 1948, op.cit. Southworth 1969: 51; see also Ohlson 1976: 40). Southworth's research was pioneering in the sense that it was the first to pay systematic attention to urban soundscape. Artificially impaired reference groups highlighted information of the kind that might have otherwise gone unnoticed.

The most comprehensive and profound studies of sonic environment in the 1970's were introduced by the World Soundscape Project (WSP) at Simon Fraser University, Vancouver, Canada. The WSP was coodinated by a composer and a professor of Communication Studies, R. Murray Schafer, and included several national and international studies, radio programmes, educational booklets, publications of soundscape issues and a vast number of recordings. The terminology and concepts are presented extensively in the *Handbook of Acoustic Ecology* (Truax 1978 & 1999).

Soundscape can be defined as "an environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by the individual, or by a society. It thus depends on the relationship between the individual and any such environment. The term may refer to actual environments, or to abstract constructions such as musical compositions and tape montages, particularly when considered as an artificial environment" (Truax 1999). Schafer launched the term in 1967 and made it widely known with the WSP. It must be noted however that Michael Southworth used the term at almost the same time (Winkler 2001: 12). Closely related to Soundscape Studies is also the term acoustic ecology, which stresses the imbalances in soundscape "which may have unhealthy or inimical effects" (Schafer 1977a: 271).

The major difference between traditional noise measurements and soundscape oriented studies is that the latter takes not just negative aspects of sound into consideration and does not concentrate only on physical measurements of noise levels. It pays attention to the "full spectrum of human acoustic experience" instead of reducing the acoustic environment to a series of measurements (Smith 1993a: 67–68).

Schafer (1977a) gives an overview of historical and present day soundscapes and introduces concepts and methods for soundscape analysis. Terms like *keynote sounds* and *signals* are based on figure-ground relationship: the former are those which are heard "frequently enough to form a background against which other sounds are perceived" for instance sounds of motors in cities[3]. Keynote sounds are not necessarily listened to consciously unlike signals, which are foreground sounds such as bells, whistles and sirens. They may even become *soundmarks* which are community sounds specially noticed or regarded by the people of community. (Schafer 1977a: 10, 272.) It must be noted, however, that any sound can be listened to consciously and therefore categorised as a figure instead of a background sound. Therefore listener's attitude or the meanings attached to either keynote sounds or signals can change their role in sonic environment (see also Truax 2001: 25).

Listeners' attitudes are also crucial in WSP's *soundwalk*. According to composer Hildegard Westerkamp (1974: 18), a soundwalk is "any excursion whose main purpose is listening to the environment" and thus makes a listener more aware of everyday sounds. Environmental listening was used as a research method in the WSP empirical studies. Schafer (1974: 17) himself makes a slight distinction between a *listening walk* and a soundwalk. According to him a listening walk is a walk with the concentration on listening whereas a soundwalk refers to a more or less guided tour or exploration of sounds heard along the way. The WSP methods were applied to two studies. In the first one (Schafer 1977b), soundscapes of five selected villages in Europe were researched and compared while the latter (Schafer 1978) focused on the soundscape of one individual city. The gradual loss of soundscape diversity and identity because of modern technological sounds were reported in both studies (Smith 1993a: 71).

An interdisciplinary approach to sonic environment was developed by Porteous and Mastin (1985). Drawing on geographical and acoustic disciplines they studied the soundscape of the South Fairfield urban neighbourhood in Victoria, B.C., Canada. The area was documented both subjectively and objectively: the latter was done by recordings, sound level measurements and expert listenings which were then analysed. In that respect the method of analysis was similar to those used in World Soundscape Project. The subjective element of the research consisted of a questionnaire-based study concerning inhabitants' general impressions of soundscape.

The classification system of sounds was found inadequate because of the wide range in individual perception. The study also indicated that the motor sounds, which are the most often heard sounds in urban environment, can function as both a figure and a ground component. In addition to this, motor sounds can mask other sound sources. (Porteous & Mastin 1985: 184.) According to Porteous (1990: 61) the objective-subjective approach values the individual elements of soundscape rather than "treating it as a single measurable object".

Isolated, smaller studies have been accomplished for instance at The Institute of Sound and Vibration in Southampton, U.K. Hawkins' (1980) research consists of interviews of the villagers in Southern England on their acoustic experiences. Hawkins concluded that residents use environmental and specific sounds as sources of information (op.cit. Smith 1993a: 73). Kariel (1990) studied the response to selected sounds within the outdoor recreational environment, and found that "it is a combination of the physical characteristics of sounds themselves and their socio-psychological aspect which determines their evaluation as pleasing, annoying, or acceptable".

Hamayon (1980) and Pocock (1987) have charted sonic environments of the cities of Paris, France and Durham, England, respectively. Hamayon provided detailed and graphic information of streets and soundscapes of the city while Pocock presented a sound portrait in audio-casette form (op.cit Smith 1993a: 73).

Numerous ethnographical studies and interviews have also been carried out by researchers and students from the Department of Music Anthropology, University of Tampere, Finland (see e.g. Järviluoma 1995, Kurkela 1991, Uimonen 1999, Vikman 1999) including the *Acoustic Environments in Change* research. After 25 years the said five European villages plus one Finnish village were revisited by a research group in order to make a comparison between contemporary and already documented soundscapes and villagers' attitudes towards them.

Christopher J. Smith (1993a) takes into consideration not only soundscape related but also geographical issues. Because of Smith's work's comprehensive nature it deserves to be introduced here in more detail. Smith's main interest is to find out how sounds are involved in residents' understanding and attachment to places. Research methods are based to soundscape studies and geographical humanism, the focus of which is "on the individual as a thinking being with human qualities, rather than as responder to stimuli" (Smith 1993a: 29).

Smith documented three different residential areas in Vancouver both qualitatively and quantitatively. Data from acoustic environments were collected by measuring the sound levels, soundwalks (Westerkamp 1974) and recordings. A tradition of Granö's "anthropocentric sonic landscape" (Smith 1993a: 68) was continued by short listening periods of different sound events which were carried out to complement the sound level measurements. Local residents were interviewed and the answers recorded. Interviewees were also asked to identify different sound samples recorded from the neighbourhood.

Residents' ability to decipher their acoustic environment can be explained by *soundscape competence* (Truax 2001: 57) or isolation of *acoustic streams* (Bregman 1978, 1990). The former means the tacit knowledge of the structure of environmental sounds while the latter refers to "human predisposition to identify and define the presence of individual sounds and their subsequent association with particular events". Drawing on Bregman, Smith states that environmental sounds are interpreted by *generic* and *non-generic* rules.

Generic rules originate from our experience of regularities in auditory world and can be compared to *Gestalt* principles of visual organisation. For instance tones when they become closer in time and/or frequency tend to group together. (Ballas & Howard 1987: 93.) Non-generic rules includes the knowledge about specific sounds and therefore relate to local experiences and situations (Smith 1993a: 401). Both rules are involved in sound recognition.

Smith perceives generic rules consistent with *general* soundscape competence and non-generic to *specific* soundscape competence. The latter refers to shared meanings attached to local sounds of specific activities or occurrences. Smith writes that new residents become familiar with the complex local acoustic environment or nuances of many local sounds only after an extended period of residence. This also holds true for

the researcher himself, especially when dealing with different places and cultures: meanings on a specific level are not necessarily easily understood by an outsider of a community (Uimonen 2000). It is these shared but somewhat local meanings that make certain sonic environments unique and distinct from the others.

Smith (1993b) divides the dimensions of residents' acoustic experience into four groups which are as follows: *sound as context*, *sound as information*, *sound and feeling*, and *sound and memory*. Sound as context refers to implicit and explicit awareness of sounds of which the former can be considered as a type of "automatic pilot" that the residents use to orient themselves in the sonic environment. Sound as information includes more conscious identification of individual sounds whereas sound and feeling category includes the sounds with meaning or sentiment that elevates them above their role as contexts or information. Sound and memory dimension linked individual sounds to past time and "far beyond the physical characters of sound themselves".

Environmental sounds have thus mnemonic qualities and they may refer to places geographically and temporally removed (see also Järviluoma 2002). Smith's results are parallel to the notion that environmental sounds carry *denotations* and *connotations* at the same time i.e. they can have both general and personal meanings (Uimonen 2002). At the level of denotations we are able for instance to recognise buildings in accordance with the established ways of thinking that are common in our culture (Aura 1982). For example different kinds of activities are thus connected to the railway station or church. In addition to this there exist connotations that are considered secondary meanings that can be attached to different kinds of objects on a personal level (Aura 1982). This might bring the third dimension to the soundscape competences or to the use of generic and non-generic rules. The meanings also exist on a highly personal level along with general regularities and shared local meanings. These personal meanings cannot be shared with other people. Otto Laske's term *sonological competence* (Schafer 1977a: 274) might also be used in this context, since it "unites impression with cognition and makes it possible to formulate and express sonic perceptions". Sonological competence may vary from individual to individual and from culture to culture.

Architects and environmental psychologists have paid attention to environment and how it is perceived although studies on it have dealt mainly with the visual aspects of perception (e.g. Lynch: 1960). However, some of the methods and theories have also been applied to auditory perception (e.g. Dyrssen 1998, Hellström 1998, Hedfors & Grahn 1998). Björn Hellström (2001a) describes the work of Swiss-French architect and a geographer Pascal Amphoux. Amphoux gives detailed instructions for carrying out research in cities. He deals with methodological questions instead of empirical facts although the method has also been tested in practice (Hellström 2001b). Parallel to WSP principles, Amphoux's work concentrates on promoting "favourable condi-

tions of an actual and specific sonic quality in space" instead of only protecting inhabitants from annoying sounds by regulations and control.

The actual study and analysis are suggested to be carried out in three different approaches. Firstly by selecting representative places for the sonic identity of a city and eliciting ideas and opinions of different demographic groups. The second approach focuses on carefully outlined sound recordings, people's perception of sound and their reactions to sonic fragments. Finally, the third approach makes an assessment by combining the first and the second approaches to a *sonic identity chart* in which the gathered information is then classified.

The sonic identity chart consists of four different modes of representations which are called *specifications of the sequences* e.g. description of sound levels and description of sonic fragments; *synthesis of the hypothesis and comments* i.e. analysis of the content of the executed questionnaires and interviews; *semantic niche and remarkable expressions* i.e. quotations from the interviews and questionnaires in original language; and lastly *objectification of qualitative criteria* i.e. description of sonic identity.

The Centre of Research on Sonic Space and Urban Environment (CRESSON) in France, has studied soundscapes since 1980's. Their multidisciplinary approach revolves around concept of *Sound Effect* which takes measurable environmental factors, cultural meanings and the "*inner* space of any individual" into consideration (Augoyard 1999: 123, emphasis in original). According to CRESSON Sound Effect is not just a physical phenomenon: it incorporates the conditions in a precise context and interpretations including the social and cultural factors. (Augoyard 1999: 123.) For instance, the auditory perception in complex sonic environments of cities has been explored with a method called *Qualitative Listening in Motion* (Tixier 2000). It includes objective measurements, ethnographic observation and a walk with the informant who handles the directional microphone to record the environmental sounds. The comments about the soundscape are taped with a small lapel microphone. The method resembles Schafer's (1977a: 212) listening walk in that sense that listener pays attention to his or her sonic environment differently than in ordinary life. It must be remembered, however, that listening is concentrated during both walks and therefore it differs from everyday perception.

A couple of recent researches concerning silent areas in populated areas have been carried out in Sweden as well as in Finland (Strömmer 2001, Sulander 2001). A study accomplished in Swedish towns Mullsjö and Habo concluded that the qualitative aspects of sound should be taken into consideration in further studies. In the Finnish town of Hyvinkää the study incorporated subjective opinions of local inhabitants in order to identify silent and relatively silent areas of town. Relatively silent areas are meant to be places that are experienced as silent i.e. "silent enough" for recreational purposes. For instance places like sports fields are included as relatively silent areas since their

"noise is legitimised" by the announcements and encouraging shouts. Furthermore, a recent Finnish study published by Ministry of the Environment (ME 2001) took both sociological and psychological aspects into account while environmental health issues in seven residential areas in Helsinki and Espoo were studied.

Auditory and cultural cognition

Parallel with qualitative soundscape studies and quantitative sound level measurements carried out in the field, environmental sounds have been in the interests of researchers of auditory cognition. Studies have been targeted, for instance, at qualities in sound frequencies that have an effect on recognising different sounds (e.g. McAdams & Bigand 1993). Tests have been carried out in controlled laboratory settings and they have often focused on the everyday sounds of everyday life.

Etymologically the word *cognition* derives from the Latin word *cognoscere*. The English word *knowledge* originates from the same word (Karvonen 2000: 85). Information mediated by hearing and other senses moulds this knowledge. Sensory information is interpreted with already acquired information which means that both sensoric and symbolic processes are involved (McAdams & Bigand 1993: 1). Generally speaking cognition is related to thinking and memory as well as perceiving information and processing of knowledge (Moisala 1991: 17).

The psychologists Ballas and Howard (1987) studied perception of environmental sounds and compared it to perception of speech. Drawing on Bregman (1978) and Vicario (1982) the writers suggest that a listener is able to make sense of the complex sonic environment by separating different acoustic events to subpatterns called *streams*. According to Bregman (1978) this segregation involves the use of *generic* and *non-generic* rules. The complementary *bottom-up* and *top-down* processes which are used to parse speech are also involved in interpreting environmental sounds. In bottom-up process features are extracted and grouped into patterns for interpretation whereas top-down processes consist of listener's expectations of a sequence of events (Truax 2001: 57).

Later Bregman (1993: 11) has refined his generic and non-generic rules. He suggests that the auditory system creates individual descriptions from the mixture of sounds. Descriptions are based on "those components of the sound that have arisen from the same environmental event." This process is called *auditory scene analysis*.

In auditory scene analysis the auditory mixture can be decomposed in three different ways: by using *schemas* and *general acoustic regularities*. Firstly decomposition can be done by activating learned schemas in an automatic way, as when people imagine they hear their names mentioned in a noisy environment. When incoming sound is close enough to the schema's acoustic definition, it becomes active. Secondly, the

schemas can be used in a voluntary way, which happens, for instance, when we are listening for a specific sound such as our name being called. These two ways of decomposing require that schemas – which can be described as "knowledge of the structure of particular sounds or sound classes that are important to us" – have already been formed by prior listening (Bregman 1993: 13).

In a new environment when sounds are not familiar, auditory mixtures can be decomposed by using *general acoustic regularities*. Unrelated sounds, for instance, seldom start or stop at exactly the same time. Another characteristic of general acoustic regularities is the gradualness of change, which means that a single sound or sequence of sounds from the same source is prone to change its properties slowly. However, it must be remembered that one should not rely on a single regularity all the way but should use many regularities at the same time in order to come to the right conclusion. (Bregman 1993: 14.) For instance, grouping by spatial origin is not effective in a reverberant environment. Continuation should also be taken into consideration, e.g. if changes in pitch of a voice are too sudden it is no longer considered the same voice. (Bregman 1993: 32–33.)

Stephen McAdams (1993) has examined aspects of auditory representations and the processes in the recognition of sound sources and events. He divides the auditory processing into five stages as follows: *sensory transduction*, i.e. representation of the acoustic signal in the peripheral auditory nervous system; *auditory grouping*; *analysis of auditory properties and/or features*; *matching auditory properties to memory representations*; and *activation of the verbal lexicon and associated semantic structures.*

Sensory transduction is a process which includes the transmission of vibrational information to the cochlea. In the cochlea the signal sets different parts of the basilar membrane in motion depending on its frequency content. Properties of sound cannot be analysed until its components have been integrated as a group and segregated from other sound events. This is called auditory grouping. It can be done by *primitive* (or bottom-up) processes, which consist of the analysis of incoming information. On the other hand, top-down or *schema-driven* processes possibly contribute to recognition in noisy environment where more familiar sound events are separated more easily. (McAdams 1993: 152.)

Analysis of auditory properties and features is accomplished after the sensory information has been grouped into representations. This analysis of perceptual features or properties that are relevant to listening is done with the help of *micro* and *macrotemporal* properties. Microtemporal properties are concerned with simple sound events whereas macrotemporal ones deal with the rhythmic and textural aspects of a whole environmental event like "dinner plates sliding, tumbling and crashing on the floor". After this the auditory properties are matched to memory representations i.e. to classes of similar sound sources and events in memory. If no category is matched – or if too many are – no recognition occurs. (McAdams 1993: 152–153.)

Recognition is then followed by activation of the lexicon of names, concepts and meanings associated with a certain class of sound events. However, the listener can act appropriately without having to verbalise what he just heard. This is proved by the fact that, children can recognise sound sources and act with respect to them even if they have not mastered language skills. Nevertheless, with language it is possible for a listener to describe the event verbally. And as McAdams puts is "At and beyond this stage the processing is no longer purely auditory in nature" (McAdams 1993: 154).

Different stages of processing do not work independently but are in interaction with each other. In addition to bottom-up processing, top-down processing is also exploited while recognising different sounds (McAdams 1993: 155). Top-down processing can be compared to Bregman's schemas and it is used in auditory organisation along with bottom up process, that is, from sensory transduction to recognition.

However it is good to bear in mind that similar sounds in different surroundings differ on a semantic level. For obvious reasons the significance of a sound of the car horn would not be the same if a person was crossing a street absent-mindedly or sitting in a cinema (McAdams 1993: 147). Therefore contextual matters should be taken into consideration while researching auditory cognition, and especially culturally constructed meanings shared by a community.

Ethnomusicologist Pirkko Moisala (1994: 186) takes the view that cognitive musicology has not paid enough attention to contextual or cultural factors. The notion is parallel to research in auditory cognition although the target of the studies in this case is the perception of sounds and how this information is processed, not music or performance practices as in musicology or ethnomusicology. However, the context is crucial in soundscape thus necessitating different kinds of research methods. This is not to say that results obtained in auditory cognition research do not contribute to soundscape studies. Different methods based on different research traditions can be combined in a multidisciplinary way to research sonic environments – this is the starting point of soundscape studies in the first place.

According to Vygotsky (Moisala 1994: 190) cognition can be divided into *elementary processes* and *higher psychological functional systems*. The former processes are unchanging aspects of human thinking and can be described as universal and genetic-biological. Higher psychological functional systems change due to socio-historical factors. Different aspects of cognition are interactive and therefore inseparable. The mental functions in the cultural development of a child appear first on the level of social interaction as an *interpsychological category*. The beginning of human consciousness is thus in processes of social life and the interpsychological category is a beginning of a child's inner *intrapsychological category*. Social and individual action is mediated by semiotic mechanisms of which one of major importance is language. With language and other semiotic processes the meanings taking place in social interaction are internalised by a human being. This also holds true for music.

Anthropologists agree that biological-cognitive capacity is universal albeit moulded by different cultural environments. Likewise psychologists separate the aforementioned elementary processes from socially and historically influenced higher systems (Moisala 1993: 66). Therefore it can be assumed that the processing of a sound is independent of cultural influence and thus universal. However, the interpretation of soundscape is affected by factors within a given place and culture. Therefore a development of local soundscape competence is a part of the enculturation process and parallel to the construction of musical competence where the social meanings are being created.

Truax (2001: 49–53) writes that there are three systems of *acoustic communication: speech, music and soundscape.* All three consist of organised sound – even soundscape if we emphasise the way the sonic environment is understood. Three major systems of acoustic communication can be placed on a continuum where the sounds increase in variety when moving from speech towards soundscape. At the same time the strictness of syntactical structure decreases since in order to be produced or understood natural languages or musical styles have to be more organised than soundscape. In soundscape the information is spread out over a longer period of time, i.e. the temporal density of information decreases. What is also decreasing is the specificity of meaning: environmental sounds acquire their meanings through their context unlike the spoken word, which can be taken out of its acoustic context in print and can still mean something. A *sound object*, i.e. environmental sound taken out of its context by recording, does not mean anything except an aural sensation, whereas *sound event* communicates if we can interpret it.

According to cognitive psychology and ethnomusicology, music is shaped by genetic and cultural factors. These factors have an effect how music is perceived, analysed and produced. (Moisala 1993: 58) This also holds true for environmental sounds except for the fact that soundscape is not consciously produced unlike a musical performance. The perception also differs in a sense that soundscape is seldom listened to as music or that this listening happens collectively like with musical performances. In the case of soundscape studies one has to organise a situation where the construction of social and cultural meanings for environmental sounds can be studied.

Meanings and recorded environmental sounds

Shared and individual meanings attached to the environmental sounds of the community can be studied with the help of group interviews supported by recorded samples of environmental sounds. Regarding shared meanings, the discussion after listening to the samples can be used to clarify what sounds are recognised easily and considered pleasant or unpleasant in a community. It must be noted, however, that the listen-

ing test is not comparable to a psychological test by any means. Instead it is supposed to activate the thinking connected to sounds and sound memories. The sounds that have been recognised and commented together can catalyse a discussion about environmental sounds in general. A somewhat similar method was used with the *Acoustic Environments in Change* project when environmental sounds were played to villagers in Cembra, Italy. The sound samples were accompanied by slides photographed in the immediate surroundings. (See Järviluoma 2000.)[4]

An experimental study was also carried out in the village of Skruv in Sweden (Uimonen 2000). The villagers took part in a sound location test in a local movie theatre in November 2000. Their task was to recognise or identify environmental sounds of the area[5]. Three different groups of people were involved one at a time: 10 children, 7 people of working age and 9 retirees. Sixteen samples were recorded from the village and its surroundings during the same year and in 1975 when the Canadian research group visited the area (Schafer 1979). The samples were played as many times as the participants wanted.

The samples were selected on the grounds that the sounds could be heard in Skruv and that they were typical for the area. Some of the samples were *narrative*: instead of just being isolated single sound detached from their contexts they referred to incidents in the surroundings. In this respect not all of the samples were exactly sound objects recorded from the environment but auditory samples of acoustic events or incidents in a village that could be recognised by the listeners participating in the test. More cues on the sonic environment were provided by the *reference sounds* in the samples: in this way the intensity of the foreground sounds could be compared to those in the background. The samples with more than one sound were selected on the basis that individual sounds are seldom heard in a soundscape.

Adult participants were asked to plot the sounds on a map, while child participants were asked to raise their hands and answer questions posed by the researchers. The villagers completed the questionnaires before the sound samples were played. The last task was to participate in a test based on a *semantic differential* in which the pleasantness of the environmental sounds was estimated by polar oppositions with different adjectives (Uimonen 2002). After the tests there was a discussion.

One of the samples consisted of ringing of the church bells. The sample was selected because of the relatively loud sound of a local church bell which divides the opinions of the villagers. The bell is located at a central place in a village and it rings louder than 80 dBA measured from Storgatan, which is the main street of Skruv 30 metres away from the belfry.

The reactions of the participants varied. Right after the beginning of a sample a subdued comment "Det räcker" ("That's enough") could be heard from the audience. One member of the audience made a joke by putting his hands over to his ears. When the participants were asked if they needed to hear the sample again somebody an-

swered "Aldrig mer" ("Never again"). The comments of the participants are quite interesting in that the sound of the bells was not recorded from Skruv, but from the church of Ljuder nearby. It is possible to hear those bells in Skruv too under favourable weather conditions. Despite this the reactions to the sound were immediate and the sample was mistaken for a bell of a local chapel.

According to Ballas and Howard (1987: 108), top-down processing of sound exploits the use of expectation, strategies or rules for interpreting the sound stimulus. However, McAdams (1993: 152) writes that top-down processing has little influence while isolated sounds are being presented to listeners. The situation, of course, differs from everyday listening. This does not exactly hold true concerning the field experiment in Skruv. If listeners are asked to recognise the sounds of their own environment, it seems that top-down processing plays a more significant role since the samples are supposed to be familiar to the listeners. The sound of the church bells, for instance, was thought to originate from the local chapel.

On the other hand both processes are utilised together. In a bottom-up process the auditory properties are matched to memory representations which leads to the activation of a lexicon of names. This is affected by already acquired knowledge of the properties of the sound heard. In addition, listeners may "mishear" sound samples such as when they think they hear their names mentioned in a noisy environment.

It must be remembered that the Skruv experiment is not comparable to controlled tests accomplished in a laboratory. Therefore it would be inadequate to use only auditory cognition to explain how people relate to the sounds of their environment. Moreover in Skruv not only single sounds were presented but the samples were narrative in nature. In this case the experiment in a way approaches an everyday listening situation when compared to laboratory tests since both top-down and bottom-up processes are involved.

The ideas and images of the sonic environment of locals also played a crucial role while recognising sound samples in Skruv. The meaning of a signal was more important to locals than listening to the sound sample in an analytical way. More precise listening would have revealed that the sound of the bell in a sample differs from the local bell. It is also noteworthy that there were several bells ringing simultaneously in the recorded sample whereas in Skruv there is only one bell, which nevertheless rings very clearly in a quiet village.

Local meanings were also strongly present when it was time for the children to recognise local environmental sounds. The clinking sounds caused by the dropping of glass jars or bottles into the recycling container were connected to local industrial activities i.e. glass blowing and a brewery instead of the recycling centre of the village. Familiar and daily sounds affected listeners in such a way that analytical listening was replaced by the sonic image of the home village or how the place is experienced. This could even be deemed to approach *sonic identity* which is supported by

the fact that Skruv is located in a district which is considered a centre of Swedish glass industry.

According to Ballas and Howard (1987: 105), a *sound homonym* is a sound that cannot be identified without contextual clues; for instance, a loud bang can be caused by a gun being fired or an engine backfire. It would be tempting also to think of environmental sounds as homonyms since sounds that sound alike in a same area can be mistaken for something else.

This raises an interesting question about the development of sonic identity. Like soundscape competence, it is part of the process of enculturation and nowadays affected by international mass media (see also Schafer 1977b & Uimonen 2002). Although our experience of sonic environment is different and dependent on our childhood milieus, the media culture has standardised its listeners. On the other hand, shared images refer to common cultural background – especially how television and movies have affected mental images. (Koivumäki 2001: 56, 63.)

Like meanings in general, personal and collective meanings of sounds tend to change. This also holds true in Skruv, since the sounds of the community have not remained the same compared to what they were twenty-five years ago. At that time the villagers estimated that the acoustically less powerful sound of Ljuder bells was spreading over a greater area than the factory whistle signals. One possible explanation for this is the cultural values attached to bells (Schafer 1977b: 50).

Today there are no factory whistle signals in the area except for the brewery whistle which is used every now and then by some merry prankster to mark the beginning of summer holiday (Järviluoma 2001: 80). The meaning of the sound that could be heard every day has now been consciously transformed into a seasonal sound. More precisely this transforming of the function of an environmental sound can be called *transcoding*. According to Stuart Hall (1999: 270) it is re-appropriating existing meanings for new meanings. Transcoding of sounds on a personal level is here extended to the whole community.

Despite the fact that top-down or schema-based recognition can misguide a listener in a test, it is good to bear in mind that there are no "right" or "wrong" answers or that correct answers are the definitive goal of the test in the first place. Samples of environmental sounds awake meanings and it seems that the relation of sound and meaning is referential. Although the meanings change and they are not fixed to sounds this is not to say that the previous meanings disappear. They may even become *sound-romances* and "thus evoke the past context and idealise it" (Truax 2001: 29). For instance, the factory siren will bring forth memories to older villagers that are beyond the reach of a younger generation. This kind of *generational memory* may also include unpleasant meanings like the sounds of war, which were mentioned in both Lesconil, France and Bissingen, Germany when the elderly villagers were interviewed during the Acoustic Environments in Change research (Järviluoma 2002). Although environ-

mental sounds are temporal in nature they often refer to events that are detached from time and place.

According to Moisala (1994: 59), cognitive ethnomusicological research should develop methods that "study cognition in real-life situations in different cultural contexts". This is closely related to cognitive social psychology. The combination of cognitive and soundscape studies is not ready to face this challenge, although it can be used to research the perception of sounds and cultural meanings embedded in them. However, the experimental method presented here can be used to make the interviews more pleasant for the interviewees since the sound-related experiences are often found difficult to express. It seems that the listening test helped participants to verbalise personal and collective meanings related to environmental sounds. The research material acquired in this way can be combined with an interview or/and questionnaire.

Testing different demographic groups can be used to research soundscape competence and how the meanings of local environmental sounds are constructed. The course of the test can be altered if necessary. For instance, it is not meaningful to test the visual perception or drawing skills of children by asking them to mark sound sources on a map. They can indicate in some other way that they have recognised the sound. The experiment might turn into a game as in Skruv, and thus become a pleasant experience for the listeners as well as the researchers.

Discussion

The field research method presented briefly above is one possible way to map personal and collective notions of everyday soundscape. Future challenges to improve this method will be to decide what kind of sounds would be most suitable for the test. Narrative samples tell stories of the environment and give clues concerning different sound events. However, the use of these samples focuses research more or less sonically diverse or quiet areas, since in urban or city environment sounds tend to be overcrowded. Auditory information received from these environments is rather one-sided: narrative aspects are lost at the same time as reference sounds are drowned by the noise of traffic.

On the other hand the strongest reactions were caused by the sample of a single sound event, i.e. the church bells. It seems that in order to evoke strong emotions in local listeners the sound does not necessarily need to be the one that is located in a given district. This notion can be also connected to the sounds of glass from the recycling centre which were thought to have originated from local industry.

While plotting sound sources to a map it must be noticed that a map is a representation and a rather limited one considering the environmental sounds. Visual representation provides the basis for the location but at the same time it may restrict or guide

the mental images of a listener. If a task included a short written description it would allow participants to express their personal feelings and connotations more freely. In this way the limitations of visual representation would be avoided, and for instance, the sounds of the past would be included in research.

It seems that schemas and top-down processes are not equal in all respects. It is true that in top-down processing an "underlying structure enhances learning of environmental sounds" (Ballas & Howard 1987: 111) and also schemas fit this description. According to Ulric Neisser (Uimonen 2002), information can only be picked up by an appropriately tuned schema. Since new incoming information changes schemas, it also changes the meanings embedded in environmental sounds. However, it must be remembered that Neisser wrote about cognition on a rather general level. Therefore it might be better to use top-down or bottom-up processes while describing auditory cognition on a personal level.

Nevertheless schemas can be useful while researching cultural meanings which are shared. Another notion borrowed from cognitive anthropology, which could be applied to soundscape studies is a *script* which means that in a given situation people tend to act in a certain way and obey certain rules (Kamppinen *et al.* 2001: 181). This holds true with sounds too, although a human being does not react to sound on the grounds of a simple cause-and-effect relationship but on the basis of culturally learned patterns excluding loud and sudden sounds, which are reacted to physically.

A listening test can assist in shedding light on the meanings attached to environmental sounds by different age groups. The method introduced in this paper incorporates contextual matters into research, although it does not replace the meaning construction in real life situation. It does not replace controlled tests either since the discussion is influenced by the comments and opinions of other participants. However, collective identification of sounds and comments can help a researcher to chart sound preferences and the important environmental sounds of a community.

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[1] Part of this article was previously published in Finnish in *Musiikin suunta* 4/2001.

[2] Terms are from 1997 translation of *Pure Geography*.

[3] For the phenomenological aspects of some of Schafer's terms see Winkler 2001.

[4] About sound samples used in field work see also Feld 1990 & Smith 1993a.

[5] In this case *recognition* means that a listener has heard the sound before. *Identification* can be considered as more narrowly focused recognition which includes the naming of a sound or a source of a sound (McAdams 1993: 148).

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