The Value of Arrhythmic Sounds in Isolated Space

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Abstract

This study examines the impact of bringing sound uninterrupted from outside a building into isolated spaces within the building. Is a silent space less or more productive than a space that is filled with normal outside sounds? Can bringing sound in from the outside, thereby allowing the users an uninterrupted connection to the outside without being in physical proximity of the exterior, make a difference in the work they do?

Using music in these spaces has become commonplace. However, this research chooses to address sounds that do not mask the arrhythmic sounds of the world. These random sounds might break a person’s concentration, just as a bird flying by a window breaks one’s concentration. Even though these sounds of nature, vehicles, and people interrupt, do they give a greater sense of place than ambient music? Do these breaks in concentration help keep an individual oriented and aware of time while increasing both comfort and connection to the work being done?

To test this thesis, students working in an isolated studio/classroom space will be subjected to the same sounds students in rooms near the outside would hear. Sounds will be provided by a direct audio link with the outside of the building. Student reaction will be evaluated by a series of observations and surveys that will focus on any differences in the amount of time spent on task, the sense of productivity experienced, the overall sense of functioning at a higher level and the interaction of student and professor.

Introduction

With the advent of modern building systems, it is common for rooms to be hidden away underground or in the core of buildings away from any possible connection to outdoor spaces. These connections were sacrificed to increase space and maximize productivity. Since the introduction of these spaces, inhabitants have sought something that would make these spaces more bearable workspaces. Visual devices such as color or art are often utilized, but the most commonly accepted way to improve these spaces has often been ambient music, or music that can be easily tuned out. Ambient music in office spaces has become commonplace. However, having sound that can be tuned out for extended periods of time causes the inhabitant to lose connection to the outside world and thus to lose track of time. Over extended periods of time inhabitants tend to get restless and productivity may drop sharply. When employees work in such a space, it becomes a treat to leave the space whenever possible. The work that has to be done there seems laborious and uninteresting.

The idea of using arrhythmic sound to make a space more enjoyable stems from
the joy of sitting outside and listening. Comparatively, sitting in a space that is closed off from the outside is similar to being closed off from what is happening in the world. Introducing arrhythmic sound into the isolated space reconnects the isolated employee to the natural environment.

Related Research

In the early 1970s, William H. Whyte advocated the design of public spaces based on how spaces were actually used by people: “Good places tend to be all of a piece – and the reason can almost always be traced to a human being” (Project for Public Spaces 2006). In 2000, architect Randolph Croyten and interior designer Kirstin Childs introduced the concept of human centered sustainable design (HCSD) into building design the United States. This was approach to design also required the integration of behavioral and psychological needs into the physical design. The concept was based on the premise of “What is the use of a building if it is not a tolerable habitat for people?” One pertinent area of the research focused primarily on the visual access to the outdoors as an important integrating medium. Studies showed improved mental functioning and stress reduction in participants. Research indicated that the use of this concept would “positively impact human health if they incorporate aspects of the natural environment that confer fitness to humans” (Weiss et al. 2004).

Disciplines other than architecture had also already extensively studied the relationship of visual access to the outdoors. In addition, many studies had been done on the impact of sound both within the design of a building and in other environments. Some of the research studied the frequency and intensity of sounds and indeed found that performance on tasks deteriorate with increased intensity of sounds. However, the results indicated more than one mechanism that underlies auditory change detection in people (Rinne et al. 2006). Some research studied the effect of irrelevant sounds or irrelevant speech in the environment on memory tasks (recalling a list of unrelated verbal items in the correct order) assigned to the participants. These sounds, usually speech, existed in the environment of the individual but were not initially important to the memory task at hand (Beaman 2004). The results of these studies were reliable and were reinforced with repeated testing over a 20-year period (Beaman 2005). For the most part, however, the research was very structured and focused on a limited type and number of sounds presented in a limited, controlled environment.

Many studies addressed the reaction of children to sounds. Some used a combination of visual and auditory stimuli. Escera’s study used novel sound, with some being identifiable and some not (Escera et al. 2000). However all of these studies also used highly controlled sounds. While they might be normal environmental sounds, none were presented in a naturally occurring manner; the intensity, volume, relevance, and timing were all adjusted.

In a review of many pertinent research studies, Beaman noted that the research of Jones and Macken in 1995 indicates that the continuous “babble” will be a less distracting phenomenon: “Increase in noise, provided it is perceived as originating
from a single source, acts to reduce the difference between successive auditory events and thus masks or reduces the stimulus mismatch within the irrelevant sound stream that causes the irrelevant sound effect.” He also comments on findings that indicate the characteristics of the irrelevant sound alone do not determine the interference. The material being processed and the methods of processing that material have a direct impact on productivity and distraction. A further complicating factor is the cognitive ability of the individual, which may make them more or less distractible. Beaman also cites Ellermeier and Zimmer’s research in 1997 that indicates people may actually benefit from irrelevant speech, but he specifies that this is an area that “has not, so far, been the subject of a great deal of research” (Beaman 2005).

Other areas of study have been diverse and less intense. For example, Steve Roden actually recorded the sounds of squeaking doors, wind in chimneys, and other natural house specific noises and incorporated them into a musical composition that plays thorough the house’s sound system (Art 2002). In a more scientific approach, Johns Hopkins University used natural sounds of waterfalls and ocean waves to control pain and stress in patients. Nearly 43% of the patients reported good results. In this experiment, however, the sound was delivered artificially through headphones (Nature 2003). Cited recently in an article in The Ecologist, R. Murray Schafer was studying the effects of sound over 30 years ago and found that natural sounds were being replaced by white noise that had the effect of breaking down the ability to listen effectively. He felt this failure to listen carefully actually impacted the human sense of community. (Listen May 2006).

While much excellent research has been done in the related areas of HCSD, sound, and potential human reaction to sound, these projects do not address authentic environmental sounds delivered directly in real time. They do not address the arrhythmic sounds of the natural environment that simultaneously vary in intensity, volume and timing. They do not address the general work environment, but tend to address only the effect on one or two specific tasks as measured by physical or mental testing at the time the sound was delivered. Perhaps more important to the architect is the general effect of sound on the habitat created within a building.

**Technical Setup**

Bringing sound in from the exterior requires specialized microphones. Research testing of directional and unidirectional microphones led immediately to the discovery that standard microphones are not powerful enough to pick up the subtle hint of distant external sounds needed for this project. Omni directional boundary microphones did have the power and sensitivity to pick up a distant car passing by or a bird chirping, and after testing they were determined the best choice.

Using a Macintosh computer and a small audio program, Garage Band, we discovered the difficulties of getting what we felt like was true to life sound. After several mini experiments, we felt that using analog mixing boards would give a better overall sound quality that was as true to life as possible.

Using Garage Band and its built in mixing board we were able to analyze
the varying wave lengths of the external sound and isolate sections for review. For instance, we were able to isolate birds chirping and make the background noise of mechanical equipment recede into the background. By using filters we were able to enhance any sound that we wanted and isolated any we didn’t like. Being able to manage sound gave us the ability to enhance the users’ experience without annoying them during work. At first the notion that we could manage the sound using a computer excited us, but after considering what manipulating the sound meant to the research we decided to only use the computer to monitor and cap decibel levels, preventing the potential scare or shock to the inhabitants. The computer also permitted us to record and play back sounds that we felt contributed to the comfort of the space. However we elected not to play recordings during the first stages of the project. After extensive testing with the computer we discovered it had extensive limitations with long periods of sound monitoring because the computer processed the sound modifying it and then outputting. We then decided to try combining the computer with an analog mixing board that we discovered gave us a better overall sound quality. The mixing board also allowed us to unplug from the computer and get a more true to life quality of sound.

Figure 1. System Diagram.
Each trial included looking for a suitable location for the placement of two Omni directional microphones. By using two microphones we were able to emulate stereo sound so if a car were passing one microphone, the other one would pick up as the car moved out of range.

Getting these microphones out of harm’s way and giving them the best possible sound field was of the highest priority. By moving them to the roof of the building we could receive a clear 360-degree sound field without reverberation or echo from hard surfaces. The microphones were mounted to an existing unused vent pipe, which was extended to get the microphones well above the building. The building also has no mechanical equipment located on the roof, so there is no interference from machinery.

With the microphones secured to the vent pipe, the pipe was used as a conduit for cabling. The top of the vent pipe was covered with a Plexiglas shield to protect the microphones from moisture and to help amplify the pitter-patter of rain. A reusable air conditioner filter was fitted to the outer edge of the Plexiglas. This filter was 8 to 10 inches away from the microphone, and while it helped shield the microphones from blowing rain, it was open enough to impede very little on the sound. The microphones also had an open cell foam windscreen that cut down on distortion from gusts of wind.

Architectural Implications

Premise

By filling a room with arrhythmic sounds, a sound that is naturally occurring and that has no obvious rhythm, ambient noise is delivered unpredictably. With the introduction of ambient music, whether it’s a genre that is totally instrumental or a popular radio station, over time the inhabitants will begin to recognize sounds and inadvertently mark time.

With arrhythmic sound this is not the case. The arrhythmic sound has the same ability to be easily ignored, but each sound is unexpected. With a mocking bird singing his song, there is a break in concentration that is overlooked in a moment. As the garbage truck picks up the dumpster behind the building, for a moment concentration is broken. This break in concentration reorients the mind and helps break the monotony of the task being preformed. The sounds filling the room are pleasing and make workers feel
Inhabiting the space

The space being used is an isolated studio in the basement of a college campus. This is a stale and cave like space. Early in the research it was suggested that painting an outdoor scene might help the space, but it was ongoing observation of personal habits that lead to the realization of the power of arrhythmic sounds. Each day many students would find any excuse to go outside the classroom even for only a few minutes. Realizing that it is almost impossible to spend all day outside when you are a student, bringing the outside in seemed important.

Early attempts were made to isolate sound and to control sound with a computer keeping the sound within a decibel range, not allowing it to peak above a specified point so not to disrupt the inhabitants to the point that they were disturbed. After reconsideration it was decided to allow those distractions just as the highs and lows would be uncontrollable if the space was in close proximity to a window. If the distraction became problematic then the sound could be adjusted to accommodate.

Early observations

For the first two days after the system was installed, every time something happened outside, the students would glance toward the speakers as if they were expecting to see the truck drive by. The hum of a continuous chiller nearby was annoying at first and wore on the patience of the inhabitants. As the day wore on, the hum acted similar to the ocean waves. It became a soothing sound that gave an audible background for other more distinct arrhythmic sounds to occur: the bells on the chapel chiming to mark the time, an intelligible word, a peal of thunder. Being able to hear something that fills the air when outside the building made the space feel as if there was an open window. One inhabitant remarked that as a gust of wind blew by the microphone they felt the breeze. It is this illusion that gives validity to the experiment.

Conclusion

Because students were present in the classroom/lab during the installation, testing, and modifying of the microphones, anecdotal results are all that have been accumulated. Those responses have been positive.

As ongoing research, beginning with the fall semester of 2006, students using this space will participate in a more formal evaluation.

1) Prior to using this space, they will be given a survey that will ask for them to review their personal study/work habits and preferences.
2) For the first 6 weeks, they will hear the arrhythmic environmental sounds.
3) At the end of that time all participants will respond to questions to determine how this has affected their usual practices.
4) They will then use the space for 6 weeks without any additional sounds.
5) The questions will ask them to compare how they personally
reacted to the lack of sound at the end of the 6 weeks.

6) The final 6 weeks will be with environmental sound and once again the students will respond. Since these are students who have studied the design and function of spaces, their observations should be more astute than a student not familiar with the principles of architecture.

7) During the entire semester, the students will be encouraged to join an online journal to record real time impressions, both positive and negative that relate to personal reactions as they encounter different study and work situations. Some of those situations may be impacted in different ways.

8) A video observation will take place for a minimum amount of time each week to note reactions that the participants may not be aware of at the time of occurrence.

At the end of the fall semester, observations, personal reactions of the participants, and anecdotal information and comparisons will have been accumulated that will verify or refute the initial findings that the arrhythmic sounds of the environment improve the productivity and sense of well being of people using an isolated space.

References


