The effects of sound on reading comprehension in an office work environment
by Lone JM Romagosa-Thomsen

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Business Education
Montana State University
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Abstract:
Purpose of Study: The purpose of this study was to determine how the type of sound in an office work environment affects reading comprehension and hence the productivity of the office. The study attempted to integrate music and noise research and to consider the possibility of interaction effects. A 3*2 Anova design was chosen to explore broad research questions about whether music, noise, or some combination of the two might affect reading comprehension.

Method: The population for this study was 287 clerical workers at Montana State University - Bozeman, listed as classified by the Personnel Office. The sample consisted of 130 individuals. Forty subjects received the Work Environment Questionnaire and 90 participated in the reading comprehension experiment. A random sampling technique was used in selecting the sample from a master list of all Montana State University Classified office workers. Three levels of music were used: none, low awareness, and high awareness. Office noise was either absent or at 60dB. The vehicle for the testing was the Standard Achievement Test (SAT I), issued in 1993 by the College Board, Princeton, New Jersey. Only the reading comprehension portion of this test was used.

Results: The study found significant differences among the subjects' reading comprehension scores based on whether no music, low awareness music or high awareness music was present in the experimental work environment. No differences were found in the subjects reading comprehension scores based on whether noise was present in the experimental work environment. Music and noise did not interact to produce significant differences in the reading comprehension scores of office workers tested in this experiment.

Conclusions: 1. Typical office noises do not affect the reading comprehension of office workers.

2. The presence of high awareness music affects the reading comprehension of office workers. Reading comprehension scores are lower during high awareness music than during low awareness music.

3. The ideal work environment would have complete silence; however, either background music, typical office noises or a combination of the two produce acceptable work performance, close to that of complete silence.

4. Interaction between music and typical office noises has no effect on the reading comprehension of the office worker.

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of the requirements for the degree

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APPROVAL

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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

Purpose of Study: The purpose of this study was to determine how the type of sound in an office work environment affects reading comprehension and hence the productivity of the office. The study attempted to integrate music and noise research and to consider the possibility of interaction effects. A 3*2 Anova design was chosen to explore broad research questions about whether music, noise, or some combination of the two might affect reading comprehension.

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Conclusions:
1. Typical office noises do not affect the reading comprehension of office workers.
2. The presence of high awareness music affects the reading comprehension of office workers. Reading comprehension scores are lower during high awareness music than during low awareness music.
3. The ideal work environment would have complete silence; however, either background music, typical office noises or a combination of the two produce acceptable work performance, close to that of complete silence.
4. Interaction between music and typical office noises has no effect on the reading comprehension of the office worker.

CHAPTER 1

INTRODUCTION

All around us the world is filled with sound. Silence - which during previous centuries was the standard - is now a luxury. Indeed, what we now call silence, is commonly a low level of background noise. Says Tom Gauntt in his article "Background music swinging into office settings"[1]: " ...these environmental sounds are so omnipresent in the office that people even cease to notice them." The question, then, becomes: How does this constant level of sound affect the workers in the office?

Definition of Sound

For the purpose of research, sound is usually divided into two categories: Noise and Music. Music can be defined relatively objectively as sound having three elements: harmony, melody and rhythm. The definition of noise, however, is more a matter of perception. Alan Hedge[2] offers the following definition of noise: "Noise is 'unwanted sound'. Noisiness is the subjective impression of how annoying the

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[1] T. Gauntt. Background Music Swinging into Office Settings. The Business Journal, Portland, June 4, 1990, pp1&3.

[2] Hedge, Alan, Ecological ergonomics: the study of human work environments. Impact of Science on Society, Winter 1992.

sound is." The general consensus in noise research, is to consider any type of sound, not included in the definition of music, as noise.

Sources of Noise in the Office

In today's offices there are many sources of noise. Some of the more common are: typewriters, computers, printers, fax machines, photocopiers, phones, environmental services (such as air-conditioning and heating), and conversation. Outside traffic noise and noise from machinery elsewhere in the building are additional sources of office noise.

Music in the Office

Only recently has music made its way into the office environment[3] and only recently has its effect been studied. Many styles of music have been listened to in offices. Says T. Gauntt: " From white noise to Talking Heads, office music is [the] hottest new beat."[4] The music heard in offices is mostly supplied by radio or personal tape collections[5], but commercial producers of work music (such as Muzak Corp. of Seattle) are slowly making their way into offices. Although music has long been a staple in other business settings,

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[3] C.Lu, A Little Office Music. Inc., Sept 1990, v12 n9 p132.

[4] T. Gauntt Background music swinging into office settings. Portland Business Journal, June 4, 1990 p 1.

[5] C. Lu. op.cit.

owners and managers of offices must first be convinced that installing music in their facility warrants the cost.

Communication Affects Worker Motivation

Providing employees with interesting and challenging work is essential to each employee's motivation[6]. Supervisors need to communicate frequently with subordinates in order to discover their innate interests and abilities and to provide appropriate opportunities for achievement and recognition for each employee.

Communication Affects Productivity

In the office work environment communication is essential to the many activities performed by managers and workers alike. The functions of management are vital to the existence of an organization and these functions are carried out through communication.

During the initial stages of planning and organizing, communication with both fellow managers and with subordinates provides the information and feedback necessary to carry out these management functions and distribute the resulting plans and goals to all parties concerned.

The managerial function of staffing thrives on communication. Supervisors use communication to determine the

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[6] F. Herzberg in L. Bittel and J. Newstrom: What Every Supervisor Should Know, McGraw-Hill, 1990, p250.

best worker for a particular position and to introduce the worker to new work requirements. Without excellent communication, staffing becomes a problem area for organizations.

Activating and controlling are, however, the stages in which communication is absolutely essential. No work would get done in an organization unless the supervisor communicates the need to begin the work. Additionally, the supervisor needs to communicate the measures of control of both the plans and goals of the organization and the performance of the employees.

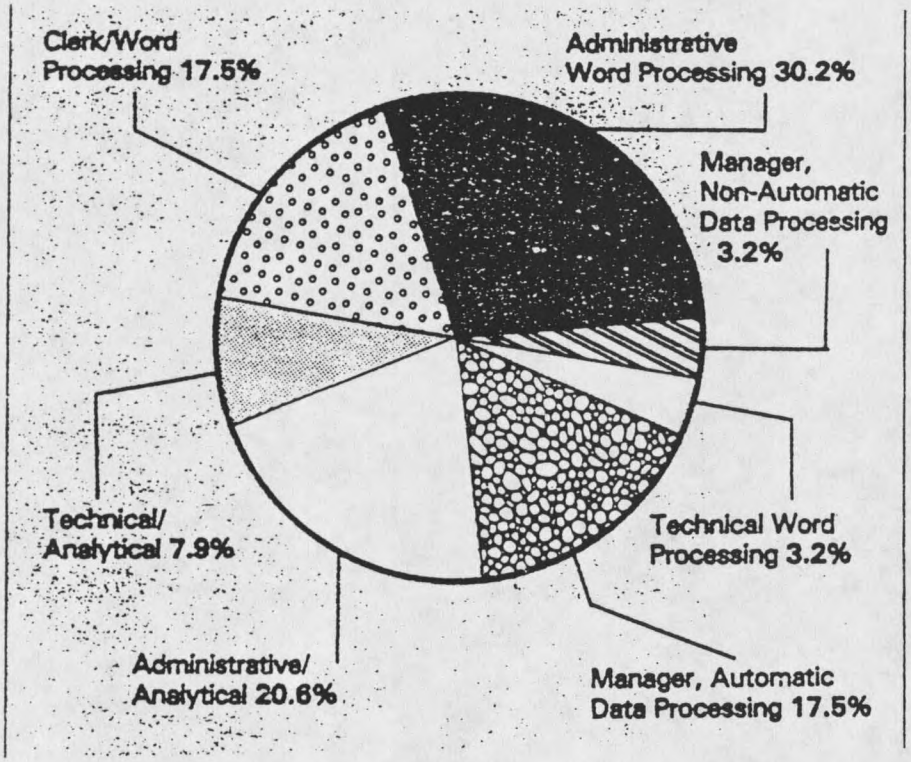
Reading Comprehension Affects Communication

Written communication is increasingly being used in interpersonal office communication. Most of the communication in offices, whether it be the president reading the annual report or the clerk reading the latest memo, involves a need to quickly and accurately interpret written information. Reading comprehension is also used when workers communicate with electronic equipment, as in data entry or network communication. With the increased use of electronic equipment in the office, written communication, and hence reading comprehension, has a greater impact on the productivity of

office work. Figure 1 below shows the use of technology in the office as of March 1990.[7]

Figure 1

Users of Technology



As this Figure shows, electronic technology is used by all levels of office workers.

Need for Study

Extensive research has been conducted on the effect of noise and music in factories (manual, repetitive work) and for

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[7] M. Monsalve, Maximizing New Technology. HR Magazine, March 1990 p85.

retail stores (the effect on both workers and shoppers). A pioneering British study[8] demonstrated an undeniable correlation between soothing music and worker productivity. Music has also been studied to determine its effect on such basic human traits as anxiety, stress and memory. Similarly, noise has been studied to determine the bodily effects to humans of exposure to noise. Early studies include the effect on blood circulation[9], and the effect on the pulse and respiration rate[10]. The results of these and similar studies have been used to improve everyday life, in such areas as determining safe noise levels for workers and in music therapy. While research on the effects of sound is abundant, specific research on the effect of noise and music in an office setting is relatively scarce.

Problem Statement

The purpose of this study is to determine how the type of sound in an office work environment affects reading comprehension and hence the productivity of the office.

Questions to Be Answered

1. To what extent is noise and music present in offices?

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[8] S. Wyatt and J.N. Langdon, Fatigue and Boredom in Repetive Work. His Majesty's Stationary Office, Report No.77, London, 1937.

[9] Dogiel, 1880.

[10] Binet and Courtier, 1895.

2. Does reading comprehension change if music is present in the office?
3. Does reading comprehension change with different types of music?
4. Does reading comprehension change if noise is present in the office?
5. Does the interaction of music and noise in the office environment change reading comprehension?

Limitations

This study is limited to clerical classified employees at Montana State University - Bozeman. The testing of these subjects was limited to determining reading comprehension scores during artificial sound conditions in an experimental testing office.

Summary

Silence is becoming rare, and two types of sound, noise and music, fill our ears. Sound affects communication, to either encourage conversation or to hinder it and communication is essential to the functions of an office. Reading comprehension is an integral component of office communication.

CHAPTER 2

RELATED LITERATURE

Much research has been done on the effects of sound in the office work environment. Most of this research has been devoted to the effects of noise, although some studies have attempted to measure the effects of music. The effect of noise on worker productivity is of concern to most businesses and even government agencies and professional associations (such as AIA (the American Institute of Architects)[11] and ASCAP (American Society of Composers, Authors, and Publishers)[12]) have shown interest in this area. The use of music to increase productivity is an issue that has excited tempers and promoted discussion for many years all around the world:

> "We denounce unanimously the intolerable infringement of individual freedom and the right of everyone to silence, because of the abusive use, in private and public places, of recorded or broadcast music. We ask the Executive Committee of the International Music Council to initiate a study from all angles - medical, scientific and judirical - without overlooking its artistical and educational aspects, and with a view to proposing to UNESCO, and to the proper authorities everywhere, measures calculated to put an end to this abuse."[13]

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[11] Architectural Record, August 1994.

[12] J. Bessman, The Music in The Malls. ASCAP in Action, Fall 1989, p27-28.

[13] R.M. Schafer, The Tuning of the World, Alfred Knopf, N.Y. 1977.

This resolution was passed unanimously by the General Assembly of the International Music Council of UNESCO, in Paris, October, 1969. For the first time in history an international organization involved primarily with the production of sound turned its attention to the reduction of sound[14]. This introduced an era full of discussion not only of the actual effects of noise and music, but also of the ethics of sound in our society. Generally, these discussions are beyond the scope of this paper, however, in some instances these discussions are used here to explain and support a point.

Five Categories of Reports on Music and Noise

Reports on the influence of music and noise can be divided into five main categories:

a) Popular articles, written in general terms and appearing in widely read magazines such as Time, Business Week, Newsweek or Reader's Digest.

b) Reports based on questionnaires and interviews.

c) Reports by governmental agencies and professional associations.

d) Promotional literature from commercial distributors of environmental music.

e) Scientific reports as the result of experimental investigations.

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[14] R.M. Schafer. op. cit. p98

Material from all of these five categories have been used in the present research study.

The Concept of Arousal

One effect of moderate levels of sound, whether that be noise or music, is arousal. In this context arousal refers to "the dimension of general alertness or activation"[15], defined in terms of nervous system activity. It is generally accepted among psychologists that there is an optimal level of arousal for performing certain activities. Above or below this optimal level, performance suffers, because the individual is over- or under aroused. Landy[16] has described the relationship between arousal and performance, showing that different tasks have differing optimal levels. The optimal level for a low-input task and for a high-input task differ in that a high-input task requires a higher level of arousal.

In the former Soviet Union, this research was translated into law. The provisions of law SNiP 785-69, stated the maximum permissible noise levels in offices:

> Offices with machinery.....60 dB
> Offices where thinking work demanding high levels of concentration occurs.....50 dB[17]

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[15] F. Landy. op. cit. pp543-545.

[16] ibid. p535.

[17] U.S. Environmental Protection Agency: An Assessment of Noise Concerns in other Nations, 1971, p.17.

The optimal level of background sound in the United States is considered between 45 and 55 decibels and although this is not mandated by law, it is common practice. If, however, the workers in a particular office are doing a variety of jobs, some involving low input (i.e. manual, repetitive tasks), while others are doing high-input (complex, mental) tasks it seems likely that at any given time some will be under- and some over aroused. This concept of arousal is integral to the effect of both noise and music in the office work environment.

The Effects of Noise

What is Noise?

To determine the effects of noise, we must first look at the types of sounds that are considered noise. While sound in general is easily definable in terms of decibel and frequency, the concept of noise is somewhat more elusive. Landy mentions that "noise is often thought to be an unwanted or an annoying sound, but this means that *noise* must be more *subjective* than *sound.*" (Italics by Landy)[18]. That this is true is further shown by Boyce, by Kraemer, Sievert & Partners and by Nemecek & Grandjean[19], who all failed to find a correlation between the

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[18] F.J. Landy. Psychology of Work Behavior. The Dorsey Press, 1985, pp521-522.

[19] As reported in E. Sundstrom, Workplaces: The Phychology of the Physical Environment in Offices and Factories. Cambridge University Press, 1986, pp132-133.

loudness of sound in offices and the disturbance by noise among employees. But as Leffingwell wrote in 1925:

> "Disturbance or irritation may arise from the peculiar nature of the sound, such as the rasping, grinding, screeching sound of the friction of metal on metal, as...from an unoiled bearing; or it may be disturbing because of its repetition, or because of echoes or reverberation."[20]

In spite of the subjective origin of the concept of noise that this definition suggests, it has been shown - objectively - that noise creates certain reactions in workers. It is the intensity of noise necessary to produce a particular response, that will change from one person to another.

Sources of Noise in the Office

In today's offices there are many sources of noise. Some of the more common are: typewriters, computers, printers, fax machines, photocopiers, phones, environmental services (e.g. airconditioning and heating), and conversation. Traffic noise from the outside and noise from machinery elsewhere in the building are other sources of office noise.

Low Intensity Noise

Most offices have a certain amount of continuous, low intensity background noise. Low levels of background noise do

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[20] W.H. Leffingwell. Office Management: Principles and Practice. McGraw-Hill, 1925.

not seem to have detrimental effects on communication, in fact Sundstrom[21] states that

> "in offices a certain amount of interference with speech is desirable, both to mask distracting sounds and to keep conversations from being heard."

Experts in office acoustics typically recommend background sounds of about 45-55 decibels[22]. In the first "open office" in the United States at DuPont's offices in Wilmington, Delaware, 40 decibels were considered too quiet. People could understand each other from far away, and it became common for workers to hush their voices. The solution was to add more sound by installing electronic sound makers[23]. The problem of speech privacy concerns the intelligibility of the sound. Intelligible speech occurs in the 2000-4000 Hertz range (the full speech range is 100-8000 Hertz) although women have voices one octave higher than men[24]. To overcome the sound problem, a sound masking system (white noise) can be installed, as was the case in DuPont's offices.

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[21] E. Sundstrom. op.cit., p283.

[22] R.A. Hansen. Unintelligibility, not audibility, determines acoustical privacy in an open plan. British Journal of Psychology, 1974 pp42-47.

[23] E. Sundstrom. op. cit.,p313.

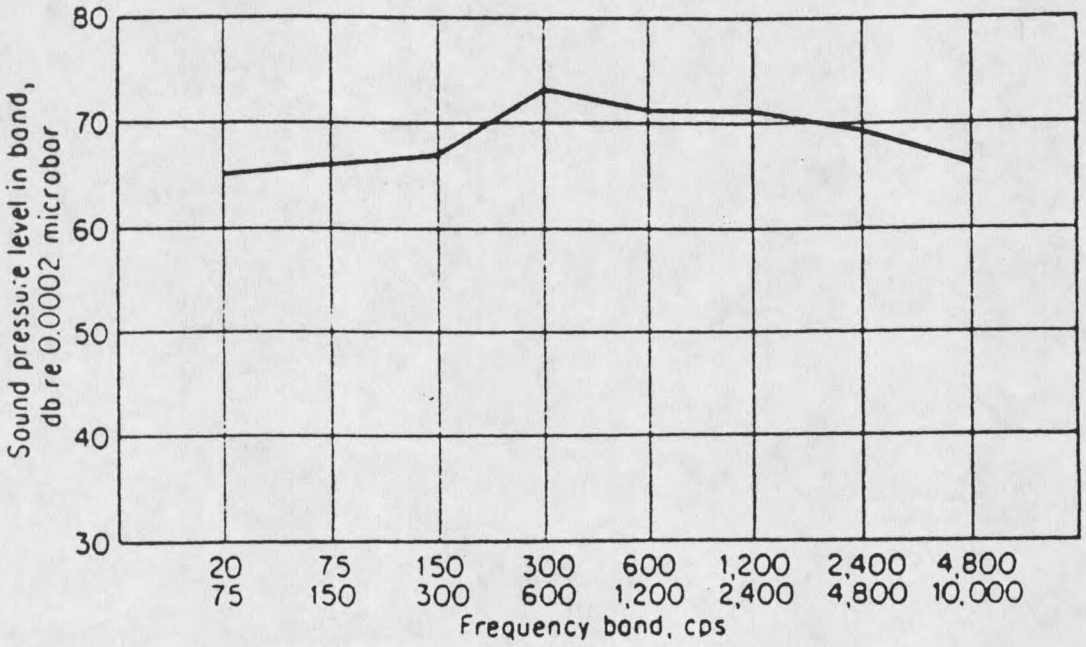
[24] A. Hedge, Ecological Ergonomics: the study of human work environments. Impact of Science on Society, Winter 1992, p62.

Moderate Intensity Noise.

Moderate intensity noise (about 50-80 dB) includes the sounds of a typical office. Although the background noise at an average office is 50 decibels, office equipment may create higher decibel levels when in use. Figures 2 - 4 illustrate examples of office machine noise, listed in decibels and frequencies[25].

Figure 2

Noise levels measured 6-10 feet from printer



[25] L.N. Miller, Case Histories of Noise Control in Office Buildings, in Noise Reduction, L.L. Beranek,Ed., McGraw-Hill, 1980, pp614-615.

Figure 3

Noise levels at a distance of 8 - 10 feet from three different types of duplicating machine

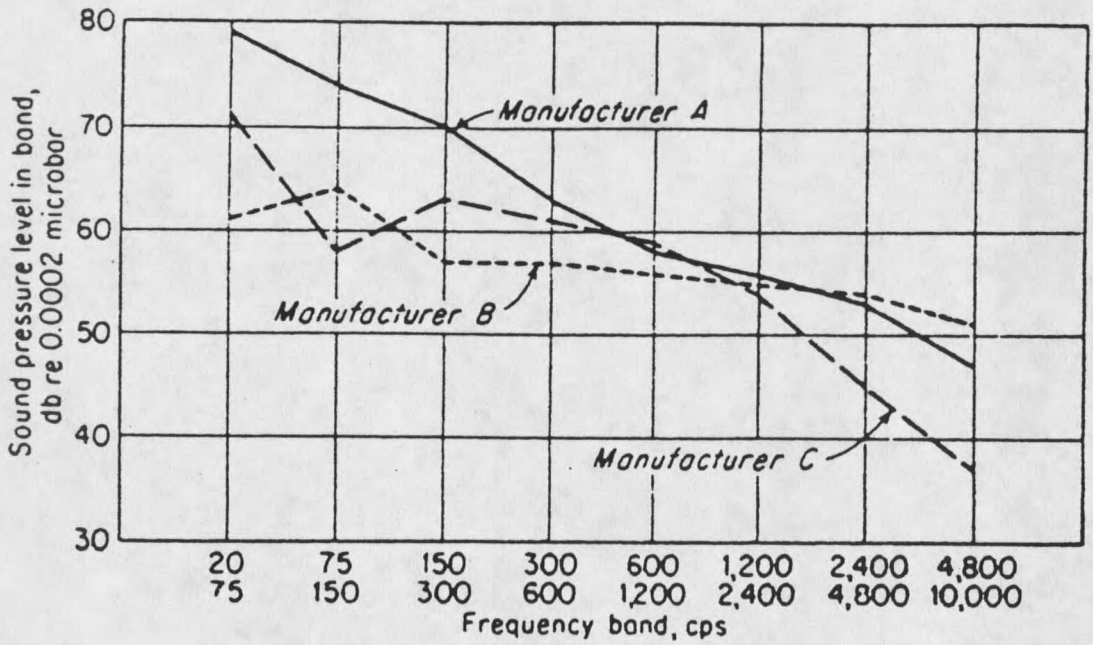
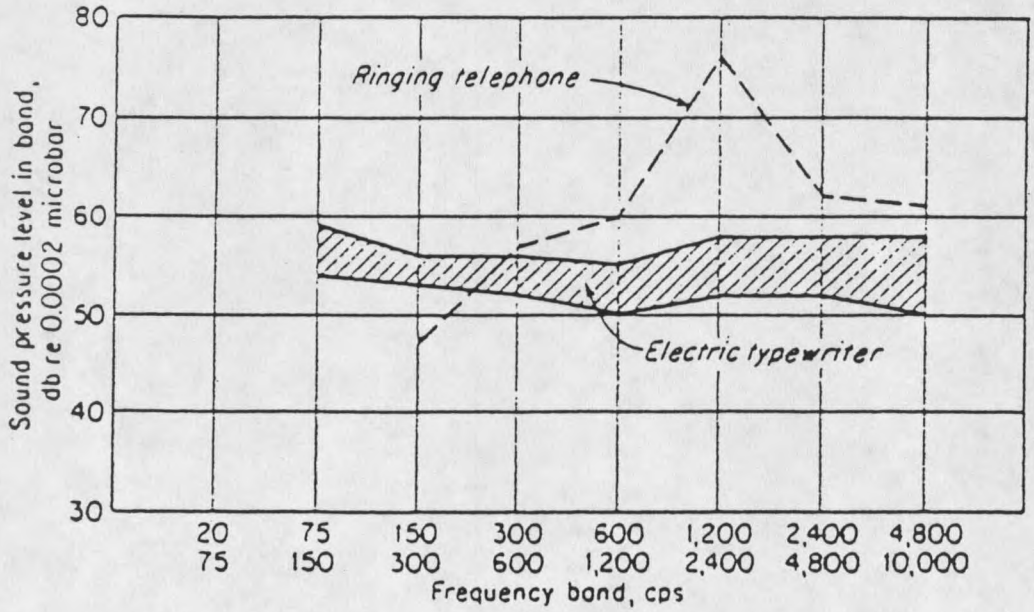


Figure 4

Noise levels at a distance of 8 - 10 feet from a ringing telephone and an electric typewriter

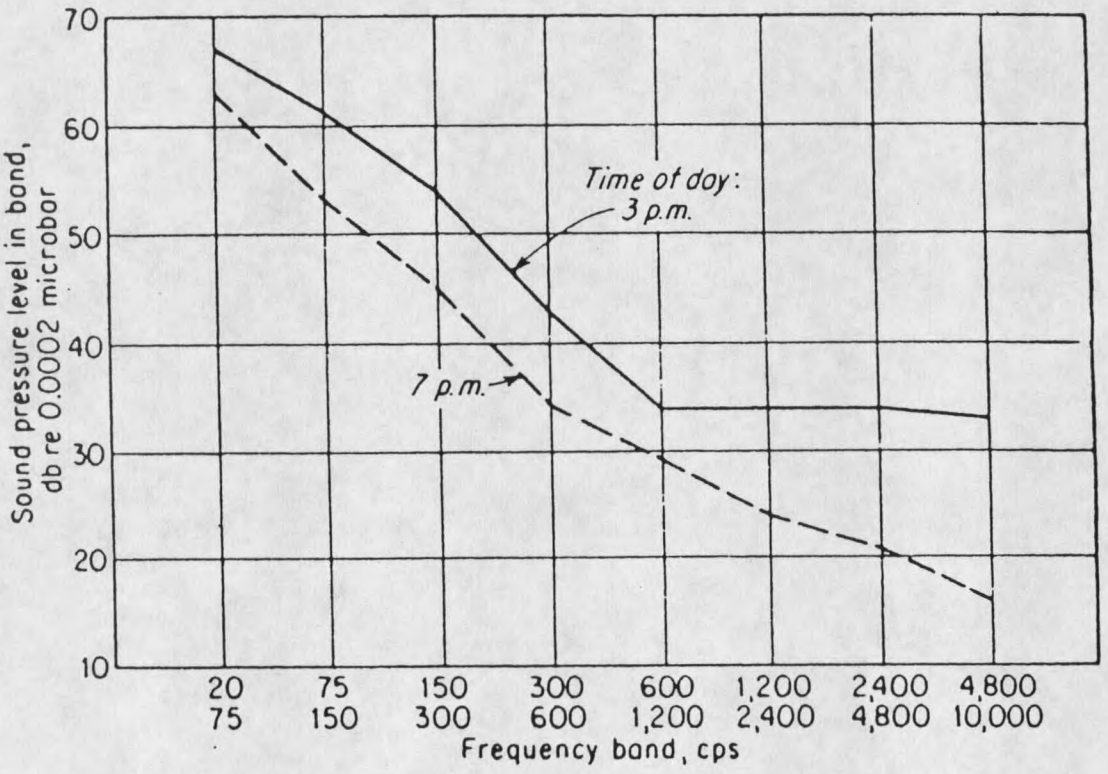


As can be seen from these examples, the noise of office machines usually falls in the upper regions of the moderate levels of noise.

Another type of noise commonly affecting offices is city traffic noise. Figure 4 below shows the difference in traffic noise as measured in a New York glass-walled office at three p.m. and at seven p.m. on a weekday[26].

Figure 5

Traffic noise in a New York office



[26] L.N. Miller, op. cit. p605.

This shows that in a four hour time span, the noise level in the office decreased 4-5 decibels on the lower frequencies due to traffic. While this may not be significant in itself, it is significant that, when added to the general level of background noise in the office, traffic noise can make the difference between acceptable and unacceptable noise levels in an office.

Physiological Effects of Moderate Intensity Noise.

The effects of moderate intensity noise on humans is both physiological and psychological. Physiological effects of noise have been studied in great detail by a number of researchers. One of the most well known studies was done by Jansen in 1956[27], with nearly 1400 workers in a variety of jobs in Germany. In this study, Jansen proved significantly altered cardiac responses between the test group and the control group. Later studies have largely confirmed these findings and Bugliarello has summarized the cardiac responses generally associated with prolonged moderate intensity noise levels as follows:

> "(they) usually tend to constrict the peripheral blood vessels, in fingers, toes and abdominal organs, and to dilate those in the retina and the brain, possibly leading to headaches."[28]

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[27] G.Jansen. Zur Entstehung Vegitativer Funktionsstorugen durch Larminwirkug in G. Bugliarello: The impact of noise pollution, Pergamon, 1975, p73.

[28] G. Bugliarello. The Impact of Noise Pollution, Pergamon, 1975.

In addition to influencing cardio-vascular responses, noise also creates hormonal reactions in workers. Levi showed that noise causes increased levels of adrenaline[29], and it has also been shown, that low frequency sound at 150 Hertz increases the release of oxytocin, the drug that stimulates the uterus during labor. In fact, Bugliarello suggests, that noise induced oxytocin levels may adversely affect the fetus and the birth-process.[30]

The gastric effects of noise have been studied by Smith and Laird[31]. In an experiment using 80 decibels of noise, they observed a reduction in the strengh of stomach contraction of 37%. This result is unambiguously large and can be generally understood to mean an increased risk of stomach ulcers.

Psychological Effects of Moderate Intensity Noise.

Moderate intensity noise has psychological as well as physiological effects. However, since psychological effects are more subjective than physiological ones, they are also more difficult to measure. As a result not as much research has been done in this area. That psychological reaction to

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[29] L.Levi. Life stress and urinary excretion of adrenaline and noradrenaline. In Prevention of ischemiac heart disease, W. Raab, Ed., 1966.

[30] G. Bugliarello. op. cit.

[31] E.L. Smith and D.A. Laird. The loudness of auditory stimuli which affect stomach contraction in healthy human beings. Journal of the Acoustical Society of America, 1930, p94.

noise exists, is clearly shown by this anecdote, related by Connell[32], in which he describes a situation where a freeway was built close to the home of a carpenter, causing the level of noise in the house to change from 30-40 dB to 80-90 dB. Says Connell:

> "He took it for some weeks. Discovered there was nothing he could do about it and his action was directed against the self. He left a note which read *"The Noise; the Noise; I just couldn't stand the Noise.."* (italics added)"

Although suicidal reactions to noise are rare - and none have been reported in an office work environment - noise does have some psychological effect on office workers.

Noise can cause irritation, tenseness and insomnia. Teichner, Arees and Reilly have studied these problems and they suggest that they are caused primarily by the changes in the intensity of noise (they used intervals of approximately 10 decibels) rather than by a particular intensity level[33].

Also interesting is the change in time judgment caused by noise. A noise level of up to 90 decibels has been shown to expand the worker's subjective time; that is, less time has been judged to pass than actually has, where a noise level

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[32] J. Connell. The biological effects of noise. Association for the Advancement of Science, 1972, p72.

[33] W.H. Teichner, E. Arees and R. Reilly, Noise and Human Performance: A psychophysiological approach. Ergonomics, 1963, v6 pp83-97.

over 90 decibels has been shown to contract the time scale[34]. Hence it seems that in the low to moderate levels of noise usually found in offices, workers will tend to feel time at an accelerated pace compared to reality.

Other effects associated with moderate intensity noise are nausea, emotional instability, argumentativeness, sexual impotency, and changes in mood[35]. These are all symptoms of general anxiety and distress and have so far eluded quantitative measuring.

High Intensity Noise

High intensity noise (above 80dB),fortunately, is not very common in offices. The most common sources are noise conducted from elsewhere in the building and noise from airplanes. Noise from other parts of the building can be transmitted through heating and air-conditiong ducts. L.N. Miller[36] has noted that noise transmitted through the wall or floor of a machinery room (such as heating and air-conditioning) will reach intensity levels of 80-100 decibels

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[34] I.J. Hirsch, R.C. Bilger and B. Deatherage. The effect of auditory and visual background on apparent duration. American Journal of Psychology, 1956 v69 pp561-574.

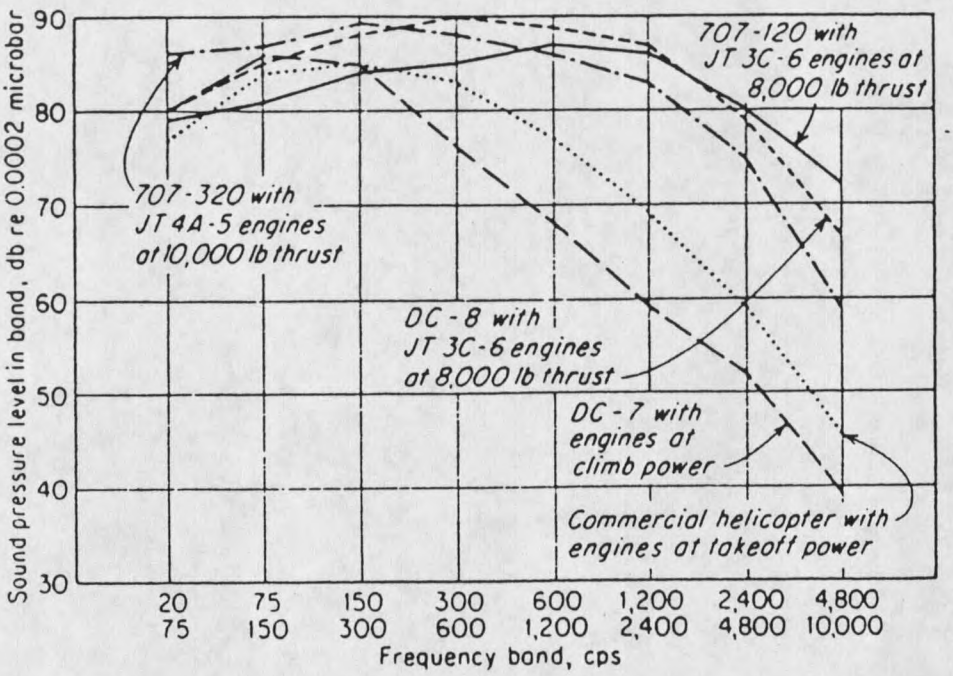
[35] J.D. Miller, General Psychological and Sociological Effects of Noise. In Handbook of Perception, E. Carterette and M.P. Friedman, Eds., Academic Press, 1978, p670.

[36] L.N. Miller, Case Histories of Noise Control in Office Buildings. In Noise Reduction, L.L. Beranek, Ed., McGrawHill, 1980, pp618-619.

in adjoining offices. Figure 6 below shows the intensity of airplane noise as measured inside a building (with 1/4 inch glass windows) at a position of 2000 ft perpendicular to the flight path[37].

Figure 6

Airplane noise inside a building



As this graph shows, most of the airplane noise, as measured *inside* the building is above 80 decibels.

Effects of High Intensity Noise

Although not common in offices, high intensity noise, where found - near airports and adjacent to ventilation machinery - has a profound impact on the employees. The physiological and psychological reactions caused by moderate

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[37] ibid. p612

levels of noise are intensified by higher levels of noise. The noise at this level is strong enough to cause debilitating illnesses and hearing loss. The U.S. Environmental Protection Agency has suggested that there is evidence of higher incidents of cardio-vascular disease, equilibrium disorders and ear-nose-and-throat disorders among workers exposed to high levels of noise[38].

High noise levels have also been found to change the activity level of the brain. Bell mentions that neurological studies have shown activity similar to that which occurs in the psychoneurosis of personality disturbance[39]. The same study also showed that workers subjected to high intensity noise had hyperactive reflexes. However, Strakhov has reported that there is doubt as to the long term effects of these changes. In his experiment he exposed the workers to noise for 2-3 minutes, and observed many of the changes noted above. Nevertheless, these symptoms disappeared 5-8 minutes after the noise stopped[40]. Although this implies that the effects of high levels of noise diminish after the noise ceases, it has yet to be proved that this study applies to the effects of long-term, consistent, high-intensity noise.

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[38] U.S. Environmental Protection Agency. Effects of Noise on People, 1971.

[39] A. Bell. An Occupational Hazard and a Public Nuisance. Public Health Paper No.30. World Health Organization, 1966.

[40] A.B. Strakhov as reported in G. Bugliarello, The Impact of Noise Pollution, Pergamon, 1976, p70.

Summary of Effects of Noise

The effects - both physiological and psychological - of noise on office workers have positive and negative implications for the communication process. The positive effect is concerned with arousal. At the optimal level of noise, an employee becomes stimulated and will both work better and interact better with fellow employees. Noise, then, can be used to achieve the desired level of arousal in workers and thereby facilitate communication.

The cardiac, hormonal and gastric effects of noise, however, have a negative influence on communication in offices. These physical reactions to noise, make a person simply not feel well, and thereby adversely affect the worker's relationship with others.

When combined with the psychological reactions to noise: irritability, tenseness, insomnia, lapse of time judgment, emotional instability, argumentativeness, sexual impotence, and moodiness, it is obvious that if the noise level in an office creates even one of these effects in each employee, appropriate communication would be extremely difficult. Even if the employees in the above scenario were to beat the odds and attempt communication, the noise would cause several workers at any given time to be distracted, and hence further complicate the communication process.

Moderate Noise Levels Have Complex Results

Research shows that low levels of background noise may be beneficial, while high levels of noise are detrimental to office work. It is in the range of moderate level of noise that we find variability in the effects of noise. Moderate levels of noise have different results based most on whether the noise is a continuous- type noise or an interrupted-type noise.

Continuous Versus Intermittent Noise

Moderate intensity noise can create distraction, usually defined as a lapse of attention or diversion of attention from the task at hand. The distraction is not caused as much by the intensity of the noise itself as by the characteristic of the noise in question; it may have a particularly annoying quality or be very interrupted and unpredictable[41]. Several studies have suggested that it is the very interrupted quality of noise that causes distraction, as compared to a continuous level of noise.

Music to Mask Office Noise

Music has been used to attempt to mask office noise, i.e. as a means to make interrupted office noise appear continuous. The type of music, commonly referred to as environmental music, will be discussed in detail below.

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[41] J.D. Miller. op. cit. p670.

The Effects of Music

What is Music?

To be considered music, sound needs to be organized to contain the three dominant elements of music: rhythm, harmony and melody. Music can be either vocal (using the human voice alone or in combination with musical instruments) or instrumental (using musical instruments other than the human voice). Music come in different styles, from Country to Heavy Metal, Easy Listening to Opera. These styles all have different sounds, different characteristics, but they all have in common the three basic elements of music.

Music in the Office

Only recently has music made its way into the office environment[42] and only recently has the effect been studied. Many styles of music have been listened to in offices. The music heard in offices is currently mostly supplied by radio or personal tape collections[43], but commercial producers of work music (such as Muzak Corp. of Seattle) are slowly making their way into offices. Music has long been a staple in other business settings, but owners and managers of offices may not yet be convinced that installing music in their facility is worth the cost.

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[42] C.Lu, A Little Office Music. Inc., Sept 1990, v12 n9 p132.

[43] C. Lu. op.cit.

Effects of Musical Mode

Several studies have shown that the major mode (popularly known as the 'happy' mode) is more effective, whereas the minor mode ('sad' music) has little or no effect on productivity. Blood and Ferriss[44] reported that listeners to music in a major mode reported significantly greater satisfaction with communication and performed significantly more tasks than did those hearing music in a minor mode.

Music to Hear But Not Listen to[45]

Numerous studies have reported that office music is more effective when it is heard, but not listened to. This type of music is commonly referred to as background music. When the music listening becomes a conscious activity and the listener is aware of the music, the worker becomes distracted and interrupts the work. Music of this type is called foreground music. As long as the music is subtle enough that the worker is not aware of it, the worker can concentrate on the work, while subconsciously listening to the music. This type of subconscious listening to background music is what has been shown by research shows as having many positive effects on office workers.

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[44] D. Blood and S. Ferris. op. cit.

[45] S. Green, Music to hear but not listen to. Saturday Review, Spet 28, 1958, p55.

Benefits of Subconscious Listening

The presence of background music in the work environment has many benefits to the worker and to the company. A listing of some of the more prominent benefits is followed by a brief discussion of each.

* Increase productivity
* Improved morale
* Improved recall of events

Music Increases Productivity

Productivity is important to businesses. The business world is becoming increasingly competitive and many companies are looking to increase their productivity as a means of remaining competitive. It has long been known that music affects productivity. Many studies, both from the beginning of the century and as well as more recent ones, support this assertion. Wyatt and Langdon[46] in 1937 reported and 11% increase in productivity, while Levyin 1965[47] reported a 8.03% increase in productivity. There are, however, conflicting opinions in the literature on this subject. Jacoby[48] reported that "Empirical studies have generally failed to support that work music makes employees happier and more satisfied, and

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[46] S. Wyatt and J.N. Langdon. op. cit.

[47] A. Levy, The Muzak Men. Horizon, 1965 v7.

[48] J. Jacoby, Work Music and Morale: A Neglected but Important Relationship. Personnel Journal, Dec 1968, v47, pp882-886.

hence, more productive. "Additionally, as Cash[49] points out, it is important to remember that the presence or absence of music is but one aspect of the workers' productivity.

Music to Improve Work Morale

Music in the work place has been linked to a reduction in absenteeism and in early departures from work as well a decrease in tardiness. A test, conducted at Stevens Institute of Technology in New Jersey showed that music in the workplace reduced absenteeism by 88% and early departures by 53%.[50] Other reports have showed a decrease in lateness of 36% at Prentice Hall as well as improved attentiveness, enthusiasm, friendliness, and tact at Eastern Airlines.[51]

Music to Help the Memory

Music has been shown to aid the memory of events. In one such study, Boltz, Schulkind and Kantra[52] discovered the following:

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[49] A. Cash, Productivity Stype. Manage, Jan 1993, p10.

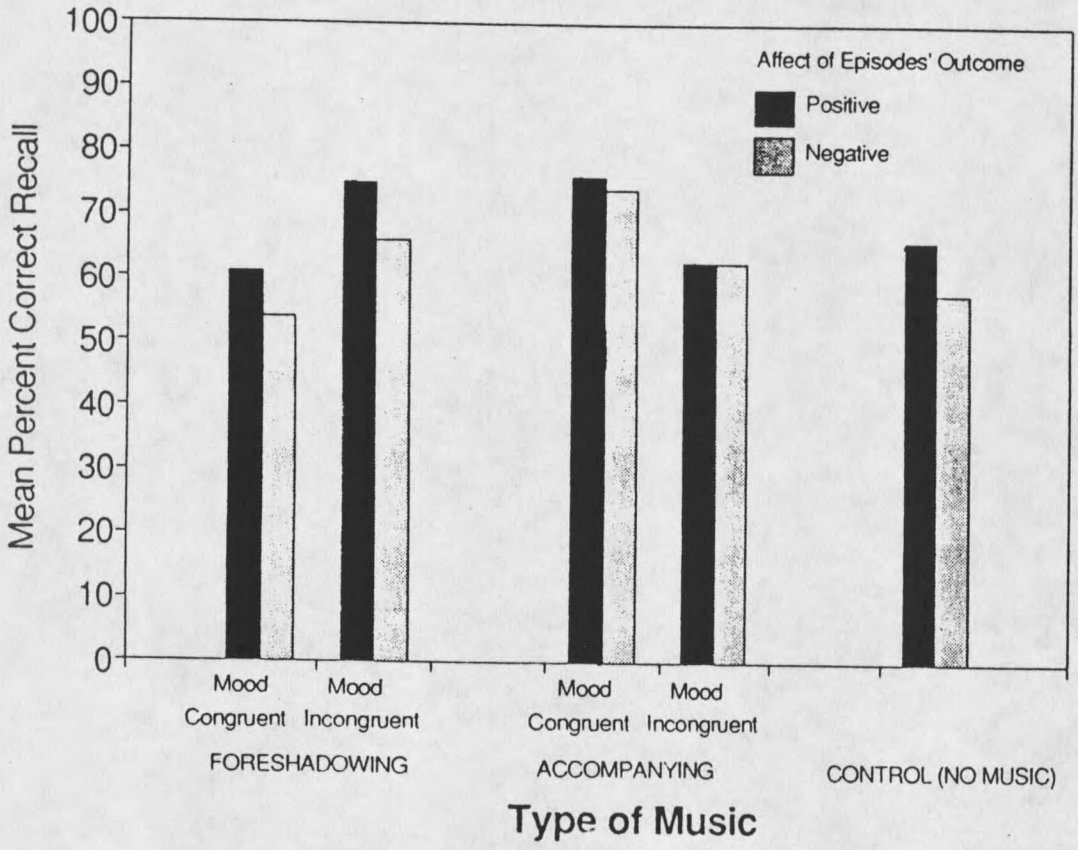
[50] O. Friedrich, Trapped in a Musical Elevator. Time. Dec 10, 1984, pp110-111.

[51] A. Levy, The Muzak Men. Horizon, 1965 v7 p40.

[52] M. Boltz, M. Schulkind, and S. Kantra, Effects of background music on the remebering of filmed events. Memory and Cognition, 1991, v19 n6 pp597-598.

Figure 7

Event recall in the presence of music



As this figure shows, accompanying (i.e. background) music produces the highest percentage of recall, especially when combined with music congruent with the events to be remembered (i.e. 'happy' music with happy events and 'sad' music with sad events). Foreshadowing (i.e. foreground) music produced a higher percentage of recall when combined with incongruent events, that is 'happy' music together with 'sad' events or the reverse. Background music overall had the higher recollection rate. This research would seem to suggest that

background music, especially when consistent with the type of work performed, will increase office workers' memory of their work activities.

What Causes Awareness of Music?

The jump from subconscious listening to conscious listening is likely to be caused by an aspect of the music, such as a sudden change in rhythm or volume or by a particular instrument taking a key role above the general level of the music (i.e. a solo). Says Jane Jarvis, the previous musical director for Muzak Corp.:

> "..penetration depends on the nature of the instruments used and their manner of use - their percussiveness and the number of impulses and accents within the arrangement."[53]

Hence, the penetration of music into the consciousness of the listener is a factor of the music and can be either encouraged or discouraged.

Environmental Music

In an attempt to eliminate the distraction that conscious awareness of music can create, several music companies (notably Muzak Corp.) have developed special arrangements of popular music - Top 40 songs as well as standard classical -

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[53] J. Jarvis, Notes on Muzak. In H.W. Hitchcock, Ed., Proceedings of a Centennial Conference Dec 7-10, 1977. Institute for Studies in American Music, City Univ. of N.Y., 1977.

in which none of the features that can cause awareness of the music is present. Commonly known as environmental music, these arrangements are designed to be unheard and to remain in the background. The music is low-intensity, undramatic and smooth-flowing - bordering on the monotone.

Opposition to Environmental Music

Musicologists have tried to analyze Muzak arrangements as works of art-music and found them greatly lacking in the key aim of art-music: involving the emotions and the intellect of the listener. Says Raymond Mount[54]:

> "Whatever it's called, just about anyone who has any vestige of taste left agrees that nothing so disastrous has hit the music world since the first singing commercial, for something called "Tasty Yeast" in 1924."

Marxists and socialists have critized environmental music as yet another opium for the people, that is, as capitalist manipulation[55]. Nevertheless, environmental music remains a useful and successful business tool.

The purpose of this music, as is stated in much of the industry's promotional literature, is to improve productivity. Several studies (both by Muzak Corp. and by independent

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[54] R. Mount Jr., Muzak: Chewing gum for the mind. Fact Magazine, Nov-Dec, 1965, p19.

[55] S. Jones and T. Schumacher, Muzak: On Functional Music and Power. Critical Studies in Mass Communication, 1992 v9 pp156-169.

researchers) have shown that environmental music does increase job satisfaction and performance, reduce anxiety, create an overall better mood and ease communication among employees, thereby improving overall productivity.

Different Effects of Music on Simple Repetitive Tasks and Complex Mental Tasks

Several studies show that the effect of music on complex mental tasks differ from the effect on simple repetitive tasks. The highly mental tasks inherent in office work are often disrupted when the worker becomes aware of the music i.e. when listening to the music becomes a conscious activity. Since so much of the work in offices today is dependent on the worker's comprehension and memory of material read, music, particularly foreground, high awareness music can be very detrimental to the productivity of office worker.

Summary of the Effects of Music

Research of office music shows that music has the power to relax and soothe the worker, while keeping arousal at optimal performance level. Hence, the effect of music in the office environment is indeed to improve productivity.

Summary of Literature on the Effects of Noise and Music

Noise and music can both be beneficial to office work. Continuous noise at low decibel levels can ease communication

and provide protection from intermittent types of noise. Low penetration music can relax the worker and boost morale. Both noise and music can provide an optimal arousal level for the performance of office work.

CHAPTER 3

METHODS

Purpose of Study

This study investigated the effects of music and office noise on reading comprehension. The purpose of this study was to determine how the type of sound in an office work environment affects reading comprehension and hence the productivity of the office.

Population

The population for this study was 287 clerical workers at Montana State University - Bozeman, listed as classified by the Personnel Office. This included most types of office workers, such as secretaries, administrative assistants, data entry clerks, bookkeepers and customer service representatives. The majority of these workers spend their entire work day in one particular office. The classifications of Professional and Administrator were not included in this experiment because these workers often do not spend most of their work day in the office; they often have the authority to determine their own schedules and leave the office when they choose.

Sample Size

The sample consisted of 130 individuals. Of these subjects, 40 received the Work Environment Questionnaire (Appendix A) and 90 participated in the reading comprehension experiment. The minimum number of subjects for each cell in an experimental study of this type is generally considered to be 30. However, since the variability of the population for this study is small and an analysis of variance is relatively robust, particularly when cell sizes are equal, a cell size of 15 should be adequate for detecting major differences.

Selection of Sample

A random sampling technique was used in selecting the sample from a master list of all Montana State University Classified office workers. Each member of the population was assigned a number and MSU-Stat (a statistical computer program) was used to select 130 numbers at random within this group. From this group, 40 subjects were chosen at random to receive the Work Environment Questionnaire (Appendix A). The remaining 90 subjects were mailed a letter (Appendix B) asking them for participation in this study. This process was repeated until 130 workers agreed to participate.

Use of Sound

Three levels of music were used: none, low awareness, and high awareness. Office noise was either absent or at 60dB. Each sound was pre-tested in the particular environment where the test was given to assure that the acoustics of the room itself would not affect the decibel level. The study attempted to integrate music and noise research and to consider the possibility of interaction effects. The 3*2 design was chosen to explore broad research questions about whether music, noise, or some combination of the two might affect reading comprehension.

Noise:

Office noise was reproduced from a audio tape of general office noise via a stereo tape player. The tape included telephone, typewriter, computer keyboard, dot-matrix printer, electric fan, photocopier, and disc-drive machinery noise, recorded in an actual office setting. This combination of noises was chosen to provide the experimental setting with both continuous and intermittent noise.

Music:

The music was produced from two audio tapes, one for each low- and high-awareness music. The low awareness music contained a selection of environmental music (background music), while the high awareness music used selections from

the categories of rock, jazz, country and classical (foreground music), such as might be found on the radio during the work day.

Testing for Reading Comprehension

The vehicle for the testing was the Standard Achievement Test (SAT I), issued in 1993 by the College Board, Princeton, New Jersey. Only the reading comprehension portion of this test was used. There were three main reasons for choosing this particular test.

1) The researcher estimated that the reading level of the test was appropriate to the expected reading level of the subjects. Many available reading comprehension tests are focused on a lower level of reading and are aimed at elementary and secondary level students. The Graduate Record Exam (GRE) was deemed too difficult reading to give accurate results to research with these subjects.

2) The only available study of the effect of office noise on reading comprehension used the SAT test (see discussion in Chapter 2).

3) The SAT is the most widely accepted and recognized reading comprehension test at this level, and it has repeatedly been shown to be both valid and reliable.

Tasks:

The first task was a questionnaire (Appendix C) designed to mask the real purpose of the experiment as well as to give a 5 minute adaptation period to the experimental conditions. It emphasized demographic questions as well as questions about the subjects' reading habits and preferences to give the impression that the experiment would be looking into gender differences in reading comprehension. This questionnaire was not designed to be analyzed and was set aside after being completed.

The reading test consisted of 10 passages and multiple-choice questions from the Verbal subtest of the Scholastic Aptitude Test I, 1993 version (Appendix D). The dependent measure was the number of questions correctly answered; no record was made of the time taken to complete the task. The subjects were given 35 minutes to complete this part of the experiment.

Before receiving the task materials, subjects were asked to read and sign an "informed consent" form (Appendix E), stating that they would be free to leave at any time if they wished to terminate their participation in the experiment.

Procedure:

Each testing day was randomly assigned one of the six combinations of music and noise formed by the 3*2 levels of independent variables. Since previous studies have implicated

time of day as a factor influencing noise effects on performance, all subjects were tested between 1 p.m. and 3 p.m.

Subjects were tested in groups of 15 and chose seats from 15 fixed positions in the room. Before testing, measurements were taken to assure homogenous sound conditions in all seating positions.

The instructions at the beginning of each testing session stated that the purpose of the experiment was to determine gender differences in reading comprehension. The instructions also claimed that the reason for the presence of music or office noise (except for the control group) was to maintain constant sound conditions across sessions, in order to control for possible differences in hallway noises and other possible sources of background noise.

The subjects were not debriefed as to the actual purpose of the experiment immediately after completing the tasks. Instead, a post-experimental debriefing (Appendix F) was sent to all participants after all data had been collected. This procedure was followed in order to assure that subsequent subjects were naive as to the purpose of the study.

Tabulation of Results:

Reading comprehension was scored as to the number of items correctly answered on the test. Reading test data were analyzed in a 3*2 analysis of variance.

Work Environment Questionnaire

The Work Environment Questionnaire (Appendix A) was mailed to 40 subjects from the same population of MSU clerical workers used in the experiment. The questionnaire results were not compared directly to the reading comprehension test results, but were collected to provide insight into the types of sound present in offices.

Types of Sound

The questionnaire listed the various types of music and the various types of noise that might be found in the typical office, asking the subjects to indicate how frequently each was heard in their office (never, occasionally, frequently or always). The results of this survey were used to classify the types of sound present in the subjects' work environment. The music was then classified as either low awareness or high awareness; whereas, the noise was classified as either continuous or intermittant. The results of this survey were also used to develop the tapes for the reading comprehension experiment.

Time Schedule

July 25, 1994	Completed Work Environment Questionnaire
July 25, 1994	Completed Cover Letter
July 25, 1994	Completed first draft of Chapters 1,2 and 3

Oct 15, 1994	Requested Master List of MSU Classified office workers from the Personnel Office.
Nov 1, 1994	Completed selection of an instrument for the reading and comprehension part of the experiment.
Nov 15, 1994	Presented research proposal to the Graduate Committee.
Nov 15, 1994	Completed recording of sound samples.
Dec 1, 1994	Completed draft copy of Chapters 1,2 and 3.
Feb 1, 1995	Completed selection of 40 workers and mailed the questionnaire and cover letter.
Feb 15, 1995	Completed taking appointments for research.
June 1, 1995	Completed research in testing office.

Summary

The population for the study was Classified Clerical Employees at Montana State University, Bozeman and a random sampling procedure was used to select 130 individuals from this group. From these 130 subjects, 40 were mailed the Work Environment Questionnaire, while the remaining 90 subjects participated in the office experiment. Subjects were tested on reading comprehension as they heard either music, noise or a combination of music and noise.

CHAPTER 4

FINDINGS

Problem Statement

The purpose of this study was to determine how the type of sound in an office work environment affects reading comprehension and hence the productivity of the office.

Questions to be Answered

1. To what extent is noise and music present in offices?
2. Does reading comprehension change if music is present in the office?
3. Does reading comprehension change with different types of music?
4. Does reading comprehension change if noise is present in the office?
5. Does interaction of music and noise in the office environment change reading comprehension?

To What Extend Is Music Present in the Office?

Of the 40 subjects who received the Work Environment Questionnaire, 35 (87.5%) responded. The results to the question on the work environment questionnaire are summarized below:

Survey question:

"What kinds of sound do you have in your office?"

For each of the following types of sound, please check how often it occurs in your office.

Use the following codes in answering the question:

N Never

O Occasionally

F Frequently

A Always

Table 1
Presence of Music

Music:	**N%**	**O%**	**F%**	**A%**
Light Rock/Pop	38.7	41.9	16.1	3.2
Country	25.8	41.9	19.4	12.9
Rock	66.7	23.3		
Jazz	67.7	25.8	3.2	
Heavy Metal	93.3	6.7		
Gospel	93.3	6.7		
Rap	90.3	9.7		
Opera	89.6	10.3		
Easy Listening	50.0	33.3	16.7	
Classical (other than opera)	70.9	16.1	9.7	
Folk	76.7	23.3		
Reggae	96.6	3.5		

Discussion

The music categories of Heavy Metal, Gospel, Rap, Opera and Reggae, were generally never listened to by these office workers. For these categories the response of 'never' was between 89.6% (opera) and 96.6% (reggae),though a few people did indeed listen to music in each of these categories while working (3.5% - 10.3). Of the high awareness music categories, these five types of music are considered the most distracting (the highest awareness).

Easy listening music is considered to be the most beneficial type of music for work performance, having the same characteristics as environmental music, which is developed specifically to increase productivity. However, a surprising 50% of the subjects never listened to environmental music, and only 16.7% listened to environmental music frequently.

The types of music most commonly listened to in these offices were Light Rock/Pop and Country. For both of these categories, 41.9% of respondents listened occasionally, with 19.3% frequently or always listening to Light Rock/Pop, and 32.3% frequently or always listening to country music.

Use of Results

The results of this question were used to develop the music samples used in the reading comprehension experiment. The sample consisted of the types of music listened to most frequently by the office workers. The music samples used in

the experiment were 1) environmental music (low awareness) and 2) Light Rock/Pop, Country, Rock and Jazz (high awareness).

To What Extent Is Noise Present in the Office?

Table 2 shows the specific types of noise present in the offices of the subjects.

Survey question:

"What kinds of sound do you have in your office?"

For each of the following types of sound, please check how often it occurs in your office.

Use the following codes in answering the question:

N Never

O Occasionally

F Frequently

A Always

Survey Summary:

Table 2
Presence of Noise

Noise:	**N%**	**O%**	**F%**	**A%**
Typewriter	9.7	70.9	22.6	
Computer	5.9	8.9	14.7	70.6
Printer		39.4	36.4	21.2
Fax machine	48.4	22.6	25.8	3.2
Photocopier	29.0	22.6	32.3	16.7
Telephone		9.1	33.3	57.6

Table 2 - Continued

Noise:	**N%**	**O%**	**F%**	**A%**
Heating and Air-conditioning equipment	32.3	35.5	16.1	19.5
Conversation, singing, whistling	9.1	42.4	48.5	
Automobiles and Trucks	43.8	40.6	9.4	6.3
Airplanes	84.4	15.6		
Emergency Vehicles	36.7	63.3		
Construction and Outside Maintenance	18.8	68.8	12.5	

Discussion

Of the office workers in this survey, 70.6% reported always having the noise of a computer in their office, with 14.7% reporting having computer noise frequently. Together, that is 85.3% hearing computer noise always or frequently while working. Additionally, 57.6% reported always hearing the telephone, with 33.3% frequently having telephone noise in their offices. This adds up to 90.9% always or frequently hearing the telephone ringing while working. Clearly, the majority of office workers are always or frequently exposed to both one type of continuous noise (the computer) and one type of intermittent noise (the telephone).

Airplane noise was infrequently encountered by these office workers, with 84.4% never hearing this noise and 15.6%

hearing it only occasionally. Heating and Air-conditioning Equipment, Automobiles and Trucks, Emergency Vehicles and Construction and Maintenance were also fairly infrequent noises with 18.8% - 43.8% never hearing these sounds and 35.5% - 68.8% hearing them occasionally. Perhaps a sign of the growing use of computers in offices, typewriter noise was heard only occasionally by 70.9% of the respondents.

Use of Results

The results of this survey were used to develop the noise sample used in the reading comprehension experiment. The noise sample used consisted of mostly computer and telephone noises, with occasional use of typewriter, printer, photocopier, heating, traffic and verbal sounds.

Grouping of the Work Environment Questionnaire Results

For purposes of analysis it was useful to sort the types of sound into two types of music and two types of noise.

Music

The music types can be condensed into the categories of high-awareness and low-awareness music as follows:

High Awareness Music :Light Rock/Pop, Country, Rock, Jazz, Classical, and Folk. The categories of Heavy Metal, Gospel, Rap, Opera and Reggae, to which hardly any office workers listen, were not included in this analysis.

Low Awareness Music: Easy Listening.

Noise

Noise can be sorted into the categories of continuous or intermittent noise as follows:

Continuous Noise: Computer, Heating and Air-conditioning Equipment, Construction and Outside Maintenance.

Intermittent Noise: Typewriter, Printer, Fax Machine, Photocopier, Telephone, Conversation, singing and whistling, Automobiles and Trucks and Emergency Vehicles. Airplanes noise was not included because very few subjects reported hearing airplanes in their offices.

The Presence of High and Low Awareness Music

Table 3 summarizes the presence of high and low awareness music in the offices of the subjects.

Table 3
Presence of High and Low Awareness Music

	N%	O%	F%	A%
Music:				
High Awareness	57.9	28.8	8.2	2.8
Low Awareness	50.0	33.3	16.7	

The Presence of Continuous and Intermittent Noise

Table 4 describes the presence of continuous and intermittent music in the offices.

Table 4
Presence of Continuous and Intermittent Noise

Noise:				
Continuous	12.7	21.1	33.2	34.2
Intermittent	20.9	34.7	25.3	19.1

Discussion

High awareness music of all types was used in offices occasionally by 28.8% of workers and frequently or always by 11% of workers. Low awareness music is used occasionally by 33.3% of the workers and frequently by 16.7% of the workers. None of the subjects in this survey reported always listening to low awareness music.

Continuous type noise was always or frequently present in an average of 67.4% of the offices surveyed, while intermittent type noise was always or frequently present in an average 44.4% of the offices.

Does Interaction of Music and Noise in the Office Environment Change Reading Comprehension?

The entire available population of 247 office workers were contacted by letter and telephone, and 90 (36.44%) agreed to participate in the study. The reading comprehension scores were tabulated using MSU-Stat. The results of the Anova are listed in Table 5. The experiment design along with the cell means is shown in Table 6.

Table 5

Result of 3*2 Anova

Model structure: 1+2+1*2
For variable: SCORE

SOURCE	DF	S.S.	M.S.
GRAND MEAN(90) = 18.27			
TOTAL (adj for mean)	89	2599.6	
NOISE	1	2.1778	2.1778
MUSIC	2	509.60	254.80
NOISE*MUSIC	2	27.822	13.911
RESIDUAL	84	2060.0	24.524

For variable: SCORE

SOURCE	F-VALUE	P-VALUE
GRAND MEAN(90) = 18.27		
TOTAL (adj for mean)		
NOISE	.09	.7664
MUSIC	10.39	.0001
NOISE*MUSIC	.57	.5692
RESIDUAL		

Testing for Interaction Effects

H_o hypothesis for interaction: Noise and music do not interact to affect scores on the reading comprehension test.

H_i : Noise and music do interact to affect the scores on the reading comprehension test.

As can be seen in the table above, the p-value for interaction (NOISE*MUSIC) is .5692. Hence, the H_o hypothesis for interaction must be retained. Music and noise do not

interact to produce statistically significant differences in the reading comprehension scores of office workers tested in this experiment.

Testing for Main Effects

H_o hypothesis for main effects of noise: The presence of noise does not affect the scores on the reading comprehension test.
H_1 : Noise does affect the scores on the reading comprehension test.

H_o hypothesis for main effects of music: The presence of music does not affect the scores on the reading comprehension test.
H_1 : Music does affect the scores on the reading comprehension test.

Does Reading Comprehension Change if Noise Is Present in the Office?

The p-value for noise is .7664. The H_o hypothesis for the main effect of noise must be retained. There is no statistically significant difference in the subjects reading comprehension scores based on whether noise was present in the experimental work environment.

Does Reading Comprehension Change if Music Is Present in the Office?

The p-value for the main effect of music, however, is .0001, showing that the H_o hypothesis for music must be

rejected. There are statistically significant differences among the subjects' reading comprehension scores based on whether no music, low awareness music or high awareness music was present in the experimental work environment.

Table 6

Cell means for Reading Comprehension Test

	No Music	Low Awareness Music	High Awareness Music	Total
No Noise	21.53	19.07	14.67	18.42
Noise	19.67	19.33	15.33	18.13
Total	20.60	19.20	15.00	18.27

Looking at Simple Effects

Table 5 shows the cell means from the 2*3 Anova. Figures 8-10 display these results graphically in order to more easily identify simple effects. Each cell shows the mean reading comprehension score for a group of subjects. A higher mean score indicates that a particular group of subjects performed better on the reading comprehension test. Looking at the cell means shows that the mean for no music and no noise (i.e. silence) is higher (21.53) than that of noise (19.67). In fact, the mean score for silence is the highest of all the cell scores, suggesting that the ideal condition for good reading comprehension is silence. The difference between silence and noise scores is the only place in this research

Figure 8

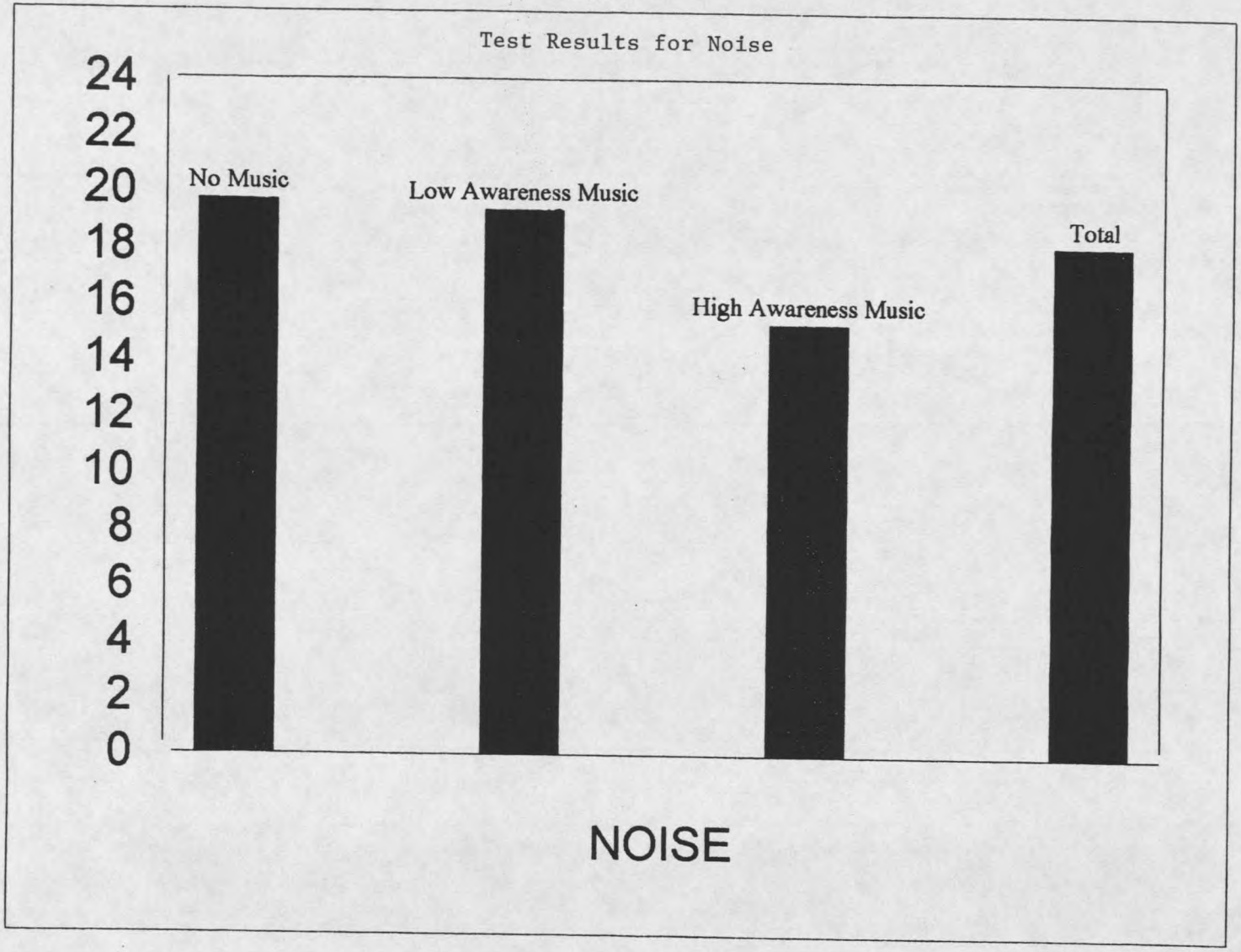

Test Results for Noise
24
22
20
18
16
14
12
10
8
6
4
2
0
No Music
Low Awareness Music
High Awareness Music
Total
NOISE

Figure 9
Test Results for Music

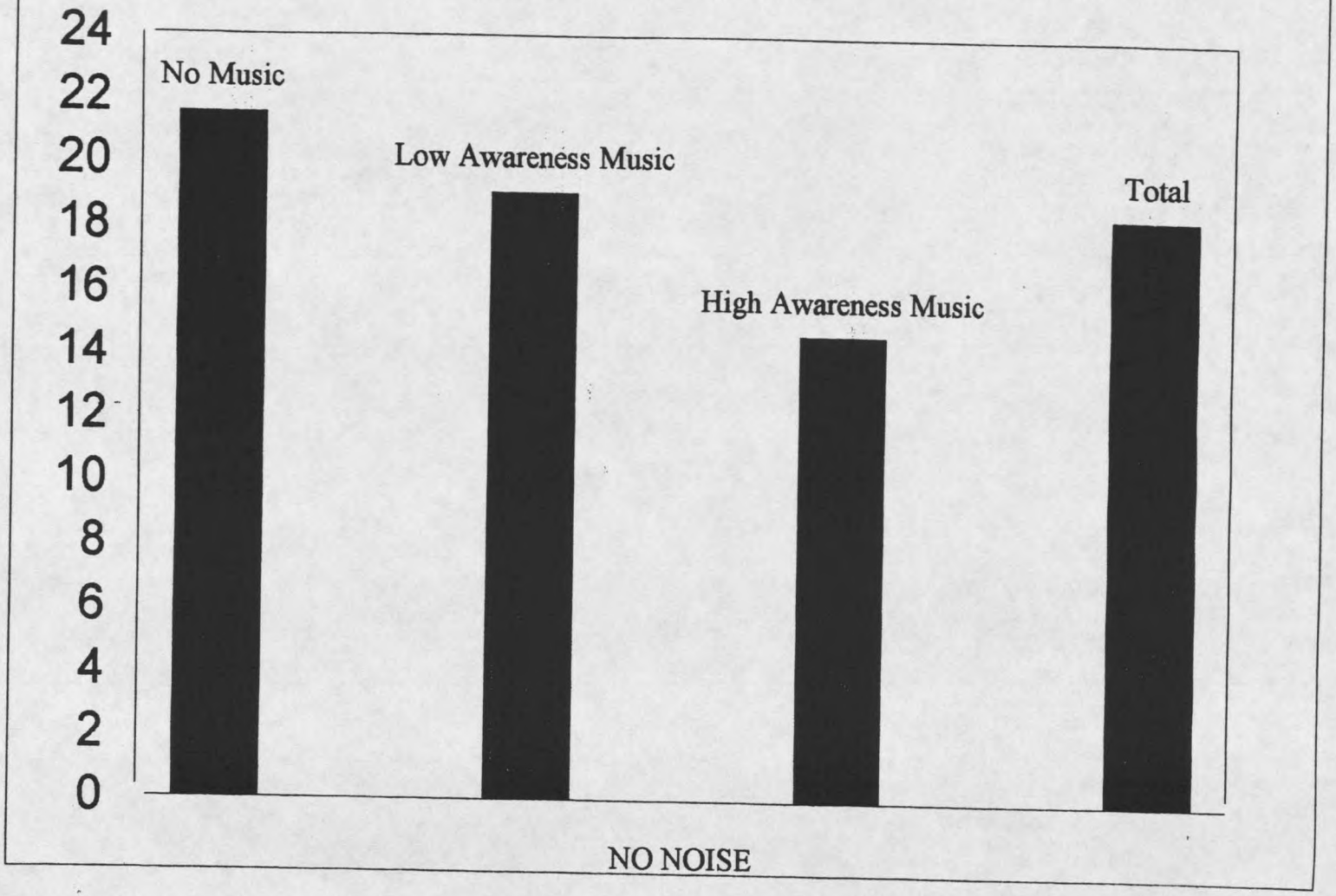
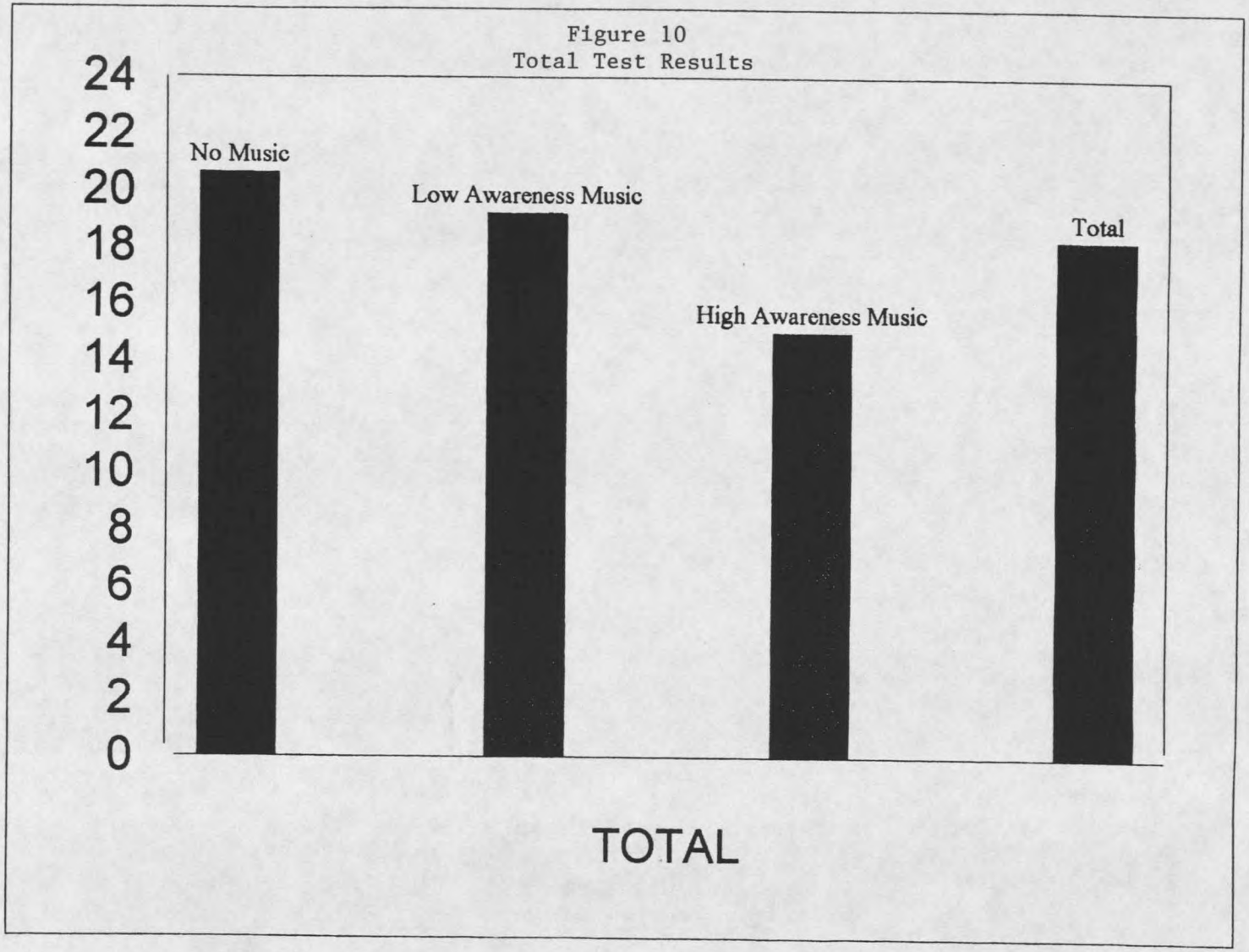


Figure 10
Total Test Results



where it seems that noise had any effects on the reading comprehension of the subjects. As shown above, the H_0 hypothesis for the main effects of noise had to be retained, showing that noise did not affect the reading comprehension scores significantly. Similarly, in the case of the simple effect of silence versus noise, an LSD statistical analysis was done, showing that even this difference is not of statistical significance.

Does Reading Comprehension Change With Different Types of Music?

The scores for low awareness music, 19.07 without office noise and 19.33 with office noise, are both similar to each other as well as to that of office noise by itself. This suggests that office noise and background music are all low awareness sounds that do not have a large impact on the reading comprehension of the office worker. Significantly, the score for low awareness music and noise together is not, as expected, higher than noise by itself, but rather lower, suggesting that noise alone, without music to 'cover it up' results in a better reading comprehension in office workers.

Finally, the scores for high awareness music are clearly the lowest of all the scores. High awareness music apparently creates a disturbance that dramatically lowers the reading comprehension performance of the subjects. The test for main effects of music above, shows that the H_0 hypothesis can be

rejected: music significantly affects the reading comprehension scores of the subjects. The high awareness music scores themselves are similar (14.67 for music by itself and 15.33 for music and noise together) again showing that the noise has no effect on the reading comprehension of these subjects. Again, as with low awareness music, the mean score for music in combination with noise is actually higher than that of music by itself.

Variability of Scores

The S.S. term is 2599.6 (showing the variability of each cell score form the grand mean). The S.S. resid is 2060.0, indicating that 20.8% of the variability of the scores can be explained by the independent variables. Noise only explains 2.1778 (.08%) of the variability of the scores, and the interaction of noise and music explains 27.822 (1.07%). Music, however, explains a significant 509.60 (19.6%) of the variability.

Literature on Noise Shows Effect on Work Performance

As mentioned in Chapter 2, many previous studies have shown the effect of noise on workers and on their work performance. Many studies show a drop in productivity when moderate levels of noise, like those of the office work environment, are present while the work is being performed. Most of those studies, however, deal with manual, repetitive

work, not with the mental tasks inherent in office work. The present study did not find a decrease in work performance in office workers during moderate levels of office noise. The workers seemed able to block out the noise, while performing their tasks. The conclusion to be drawn from this is that although noise affects manual repetitive work it does not appear to affect mental work.

Why Does Noise Show No Effect on Reading Comprehension?

One possible reason why noise did not appear to affect the reading comprehension scores would be that the office workers over time have become accustomed to these particular types of noise, and hence, are better able to ignore these noises than they would be with other types of noise. To determine the validity of this statement, a new experiment could be developed, using the same basic approach as the present study, but using additional types of noise and subjects who have not previously worked in an office.

Interaction of Music and Noise

In Chapter 2, it was mentioned that there is no published research on how noise and music interact in the work environment to affect work performance. The results of this study, showing no interaction effects of noise and music on work performance, would seem to indicate that similar studies may have been done, but not published, due to the lack of

statistically significant findings. Common sense would suggest that the types of sound present in a particular environment would interact to produce an effect on the listener, however, research shows no such effects.

Background Music Does Not Mask Office Noise

Some studies, particularly those done by Muzak Corp. and similar producers of environmental music, claim that low awareness music is capable of increasing productivity, by masking the noise found in the work environment. Most of this research was done on simple, repetitive, manual work, and does not necessarily apply to the highly mental tasks of office work. The companies presenting this research have, however, used their findings to try to market their services to office personnel. The present study shows clearly, that low awareness, environmental music does not have any effect on the work performance of office workers, compared to the work performance during noise, not masked with environmental music. The productivity of the office worker was not increased by using environmental music to mask typical office noises.

Foreground Music Affects the Quality of Work

High awareness, or foreground, music had a detrimental effect on the work performance of the office workers in this experiment. This result was expected, based on the general literature on the subject, surveyed in Chapter 2. Research

shows that for simple, manual work, conscious listening to music decreases the work performance and the productivity of the worker. Mental work, such as the reading comprehension engaged in by office workers, would also be expected to deteriorate with the presence of high awareness music. The conscious act of listening to music distracts the worker, taking time away from the work and often causing the worker to have to redo a particular part of the work.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Previous research has shown both noise and music to have an effect on work performance. Noise at the decibel level of most office machines has been shown to have a negative effect on work performance and productivity, as has high awareness music. Low awareness (environmental) music has been shown by previous research to have a positive effect.

In the present study both noise and low awareness music appeared to have no effect on reading comprehension scores. High awareness music, however, had a negative effect on the scores, lowering the work performance of the office workers.

The responses to the Work Environment Questionnaire show both continuous and intermittent noise to be common in offices. Intermittent noise would appear to be a concern because previous research suggests it would lower productivity, but this study shows that noise did not have the same effect on the mental work of office workers as it did in studies involving manual, repetitive tasks.

The most common music in offices is high awareness music. In both this study as well as in previous research, the effect of having high awareness music in the work place has been shown to be a lowering of work performance. Previous

studies have shown high awareness music to have this effect on manual work and on mental tasks; the present study shows a significant lowering of reading comprehension scores, when workers listen to high awareness music while working.

The interaction of noise and music in the office work environment did not explain the variability of the reading comprehension scores of the office worker beyond that explained by each variable separately. However, since both noise separately, and the interaction of music and noise do not explain a significant amount of the variability of the scores, the most significant finding of this study is the fact that the presence of music does explain a large portion of the variability of the scores.

Conclusions

1. Typical office noises do not affect the reading comprehension of office workers.

2. The presence of high awareness music does affect the reading comprehension of office workers. Reading comprehension scores are lower during high awareness music than during low awareness music.

3. The ideal work environment would have complete silence; however, either background music, typical office noises or a

combination of the two produce acceptable work performance, close to that of complete silence.

4. Interaction between music and typical office noises has no effect on the reading comprehension of the office worker.

Implications

This study suggests that the recent trend in using environmental music in office settings does nothing to increase the productivity of the office workers. Since there is no significant difference between the scores for noise and noise with background music, any product or program to mask the effects of noise by using environmental background music in order to increase productivity is questionable. It appears that the well-documented effects of environmental music on productivity in manual, repetitive work situations are not replicated in the mental work required in most offices. Hence, business owners and office managers should question using resources to install environmental music in hopes of increasing productivity.

The use of foreground, high-awareness music in many offices today (28.8% occasionally and 11% frequently or always) does, however, have an impact on the productivity and the work performance of the office worker. The reading comprehension scores were significantly lower during high-awareness music, showing that the worker does not perform as

well while hearing this type of music. This study suggests that the best way for businesses to increase the productivity of their office workers would be to ban foreground music (such as that commonly found on radio stations during the daytime) from their offices.

The study also shows no effect of the presence of noise on the reading comprehension scores. This would suggest that the presence of typical office noise at a moderate decibel level does not affect the productivity of the office worker.

Recommendations

This study should be replicated in such a manner as to eliminate the possible effects of long-term office workers having over the years become accustomed to typical office noise. One way to do this would be to use the same experimental approach, but to have two groups of subjects, one which would come from a population of long-term office workers and one which would come from a population of non-office workers. In this way it would be possible to validate the most surprising result of this study: that typical office noises do not affect reading comprehension.

Additionally, it would be interesting to repeat the study using the two types of noise, continuous and intermittent, in separate sound samples in order to examine whether the effect of each type of noise matches that of the combined noise used in the present study.

A similar experiment should also be done to determine the effect of sound on listening comprehension, another type of office communication. Ideally, the same sounds (noise, low-awareness music and high-awareness music) should be used in experiments with both reading comprehension, listening comprehension and manual, repetitive work in order to examine possible differences. Groups of both office workers and non-office workers should be used in these experiments.

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APPENDICES

Appendix A
Work Environment Questionnaire

WORK ENVIRONMENT QUESTIONNAIRE

Name:_____

What kinds of sound do you have in your office?

For each of the following types of sound, please check how often it occurs in your office.

Use the following codes in answering the question:

N Never
O Occasionally
F Frequently
A Always

MUSIC

Light Rock/Pop	[ ]N [ ]O [ ]F [ ]A
Country	[ ]N [ ]O [ ]F [ ]A
Rock	[ ]N [ ]O [ ]F [ ]A
Jazz	[ ]N [ ]O [ ]F [ ]A
Heavy Metal	[ ]N [ ]O [ ]F [ ]A
Gospel	[ ]N [ ]O [ ]F [ ]A
Rap	[ ]N [ ]O [ ]F [ ]A
Opera	[ ]N [ ]O [ ]F [ ]A
Easy Listening	[ ]N [ ]O [ ]F [ ]A
Classical (other than opera)	[ ]N [ ]O [ ]F [ ]A
Folk	[ ]N [ ]O [ ]F [ ]A
Reggae	[ ]N [ ]O [ ]F [ ]A
Other_____	[ ]N [ ]O [ ]F [ ]A

NOISE

Typewriter	[ ]N [ ]O [ ]F [ ]A
Computer	[ ]N [ ]O [ ]F [ ]A
Printer	[ ]N [ ]O [ ]F [ ]A
Fax machine	[ ]N [ ]O [ ]F [ ]A
Photocopier	[ ]N [ ]O [ ]F [ ]A
Telephone	[ ]N [ ]O [ ]F [ ]A
Heating and Air-conditioning equipment	[ ]N [ ]O [ ]F [ ]A
Conversation, singing, whistling	[ ]N [ ]O [ ]F [ ]A
Automobiles and Trucks	[ ]N [ ]O [ ]F [ ]A
Airplanes	[ ]N [ ]O [ ]F [ ]A
Emergency Vehicles	[ ]N [ ]O [ ]F [ ]A
Construction and Outside Maintenance	[ ]N [ ]O [ ]F [ ]A
Other_____	[ ]N [ ]O [ ]F [ ]A

Appendix B
Cover Letter for Reading Comprehension Experiment

April 18, 1996

Dear Subject,

As an office worker on our campus, you are one of 90 individuals randomly selected to participate in a research project. The project is concerned with gender differences in reading comprehension.

Your part of this study will take approximately 45 minutes. You will be asked to complete the reading comprehension portion of the SAT test. The test will be conducted in Room 415, Reid Hall. All parts of the research are confidential, but if you choose, your score, as well as the general results of the study, will be mailed to you after the study is completed.

I would like to schedule your appointment at 1:15 p.m. on one of the following days:

Tuesday, March 14
Wednesday, March 15
Thursday, March 16
Friday, March 17

I hope one of these days will be convenient and will allow you time to arrange for your participation. I will contact you this week to determine your availability.

I am conducting this study as part of my program for a Master of Science degree in Business Education and I will appreciate your help in completing this study.

Sincerely,

Lone Romagosa
MSU Graduate Student

Dr. Norm Millikin
Graduate Advisor

Appendix C
Reading Habits Questionnaire

READING HABITS QUESTIONNAIRE

Please answer a few questions about yourself?

Sex: [ ]male [ ]female

Age: [ ]20-29 [ ]30-39 [ ]40-49 [ ]50-59 [ ]60+

Average amount of hours you read each week:

[ ]under 5 [ ]6-10 [ ]11-15 [ ]16+

Style of reading material preferred:

[ ]fiction [ ]non-fiction

If fiction:
(check all that apply)

[ ]romance

[ ]mystery

[ ]western

[ ]science fiction

[ ]classics

[ ]poetry

[ ]other_____

Appendix D
Reading Comprehension Part of the SAT Test and the Answer Key

Section 1

Each passage below is followed by questions based on its content. Answer the questions following each passage on the basis of what is stated or implied in that passage and in any introductory material that may be provided.

Questions 16-21 are based on the following passage.

The following passage is an adaptation of an excerpt from a memoir written by Elizabeth Bishop about the poet Marianne Moore. Bishop herself became a well-known poet.

I became a devoted reader of Marianne Moore's poetry while attending college in the early 1930's. A school friend and her mother, both better read and more sophisticated in their literary tastes than I was, were the first to mention her poetry, and soon I had read every poem of Moore's I could find.

I had not known poetry could be like that: her treatment of topics as diverse as glaciers and marriage struck me, as it still does, as a miracle of language and construction. Why had no one ever written about these things in this clear and dazzling way before?

As luck had it, when I first began searching for a copy of her volume entitled *Observations*, I found that the college library didn't own one. Eventually, though, I did borrow a copy, but from one of the librarians, Fanny Borden, not from the library. And I received an invitation to meet Marianne Moore in the process.

In retrospect, Fanny Borden seems like a most appropriate person to have suggested I might meet Marianne Moore. Borden was extremely shy and reserved and spoke in such a soft voice it was hard to hear her at all. The campus rumor was that her personality had been permanently subdued by her family history: the notorious Lizzie Borden* of Fall River was her aunt.

Contact with Fanny Borden was rare. Occasionally, in search of a book, students would be sent to her office, shadowy and cavelike, with books piled everywhere. She weighed down the papers on her desk with smooth, round stones, quite big stones, brought from the seashore. My roommate once commented on one in particular, and Borden responded in her almost inaudible voice, "Do you like it? You may have it," and handed it over.

One day I was sent to her office about a book. During our talk, I finally got up my courage to ask her why there was not a copy of *Observations* by that wonderful poet Marianne Moore in the library. She looked ever so gently taken aback and inquired, "Do you like Marianne Moore's poems?" I said I certainly did, the few I had been able to find. She then said calmly, "I've known her since she was a girl," and followed that with the question that was possibly to influence the whole course of my life: "Would you like to meet her?"

I was painfully—no, excruciatingly—shy and I had run away many times rather than face being introduced to adults of much less distinction than Marianne Moore. Yet I immediately said, "Yes."

*Lizzie Borden, the defendant in a highly publicized trial, was accused of murdering her parents.

16 To the author, Marianne Moore's poetry was

(A) reminiscent of poems by other great poets
(B) subtly satirical
(C) too scholarly for most readers
(D) inspiring and well crafted
(E) difficult but rewarding

17 The major purpose of the passage is to

(A) describe the events that led to a milestone in the author's life
(B) reveal the character of a college librarian
(C) relate the significant events of the author's college years
(D) analyze the impact of Marianne Moore's poetry on the author
(E) show the unexpected surprises that can happen in an ordinary life

Section 1

18 The reference to Lizzie Borden in line 24 provides all of the following EXCEPT

(A) one possible reason for the librarian's unusually quiet manner
(B) a piece of information about the librarian's family history
(C) a suggestion that the librarian might be deliberately hiding her true nature
(D) an indication that the students were curious about the shy librarian
(E) a fact that might be interesting to some readers

19 By mentioning the extent of her shyness (lines 45-48), the author primarily emphasizes

(A) her reasons for not asking Borden to introduce her to Marianne Moore
(B) her awareness of her own weakness
(C) how important meeting Marianne Moore was to her
(D) how hard it was for her to talk to people, even Borden
(E) how different her encounter with Borden was from her roommate's

20 The author most likely remembers Fanny Borden primarily with feelings of

(A) regret
(B) curiosity
(C) amusement
(D) gratitude
(E) loyalty

21 The passage suggests that the author's interest in meeting Marianne Moore was

(A) ultimately secondary to her interest in locating a copy of *Observations*
(B) prompted by a desire to have the poet explain a difficult poem
(C) motivated by the idea of writing a biography of the poet
(D) a secret dream she had cherished for many years
(E) sufficiently strong to make her behave uncharacteristically

Section 1

Questions 22-30 are based on the following passage.

There has been a great deal of scientific debate about the nature of the object that exploded above Tunguska in 1908. The following passage presents one theory of what happened.

The thought came and went in a flash: there was not a chance in a billion years that an extraterrestrial object as large as Halley's comet would hit the Earth. But that was 15 years ago, when I had little appreciation of geological time. I did not consider then the adage that anything that can happen does happen—given the time. My intuition was right—there is not a chance in a billion years for a big hit—but there have been more than 4 billion years of Earth history. Smaller collisions have happened frequently, as evidenced by many ancient impact craters. Even during the brief period of human history, there was a very real event at Tunguska.

Tunguska was a quiet hamlet in central Siberia. At 7:00 a.m. on June 30, 1908, a fireball appeared above the horizon to the southeast. More luminous than the rising Sun, the bright light streaked across the cloudless sky and exploded somewhere to the northwest. The scale of the explosion was unprecedented in recorded history. When seismographers consulted their instruments and calculated the energy that had been released, they were stunned. In today's terms the explosion had the force of a 10-megaton nuclear detonation.

The brilliant object had been seen for hundreds of kilometers around, and the explosion was heard as far away as 1,000 kilometers.* The shock wave of wind circled the globe twice, and the ejecta from the explosion glowed over Northern Europe through the next two nights. Vast amounts of fire debris arrived at California two weeks later, noticeably depressing the transparency of the atmosphere over the state.

Fortunately, the object had exploded at a height of 8.5 kilometers above the ground, and the fall region was very sparsely populated. Hunters who were first to enter the disaster area reported that the whole forest had been flattened and gave accounts of wild forest fires. Systematic investigations did not begin until two decades later. The first team of experts visited the target area in 1927. They endured hardship to penetrate the devastated forest with horse-drawn wagons to investigate the aftereffect of the blast. Their mapping showed that trees within a radius of 30 to 40 kilometers had been uprooted and blown radially outward from the center of the blast. Within the blast zone, an area of 2,000 square kilometers had been ravaged by fire.

Study of the Tunguska site resumed after the Second World War and is still continuing. Although no meteorites have ever been found, soil samples from Tunguska contain small spherical objects similar to tektites, black glassy objects commonly believed to result from the impact of a meteorite. The material of which tektites are usually composed is only slightly contaminated by extraterrestrial substances from the meteorite itself. The spherical objects found at Tunguska have been compared to small tektites, or microtektites, which are commonly a fraction of a millimeter in diameter, but the chemical composition of the Tunguska objects resembles cosmic dust. Apparently they were not ejecta thrown out of an impact crater, but were derived directly from the explosion above the Earth, and descended as extraterrestrial fallout.

What was it that exploded on that sunny morning over Siberia? Astronomers have conjured everything from black holes to balls of antimatter, but dramatic as the Tunguska event was, it does not seem to require an exotic explanation. The more likely interpretation is conventional: the object was a large meteor.

22 In line 1, the statement "The thought came and went in a flash" refers to the idea that

(A) intuition is important in scientific research
(B) the Earth is immensely old
(C) the speed of Halley's comet is difficult to calculate
(D) the Tunguska event had an extraterrestrial origin
(E) the Earth could experience a collision with a large comet

23 In line 4, the word "appreciation" most nearly means

(A) increase in value
(B) artistic interest
(C) understanding
(D) curiosity
(E) gratitude

** One kilometer is equal to 0.62 miles. One thousand kilometers equals 620 miles.*

Section 1

1

24 In the third paragraph, the author mentions Northern Europe and California in order to emphasize which point about the Tunguska event?

(A) Although the explosion was locally destructive, the remainder of the world escaped harm.
(B) The magnitude of the explosion was so great that its effects were observable over much of the Northern Hemisphere.
(C) Although the explosion occurred in a remote area, more densely populated areas were also devastated.
(D) No part of the Earth can consider itself secure from the possibility of such an explosion.
(E) The explosion took place in the atmosphere rather than on the ground.

25 The word "depressing" in line 31 most nearly means

(A) reducing
(B) saddening
(C) indenting
(D) constraining
(E) probing

26 Which is most similar to the design of the fallen trees indicated in the 1927 "mapping" mentioned in line 42 ?

(A) The gridlike pattern of a checkerboard
(B) The spokes of a wheel
(C) The parallel lanes of a highway
(D) The spiral of a whirlpool
(E) The steps in a staircase

27 The author uses the evidence of tektite-like objects in the soil (lines 48-62) to establish that

(A) the Tunguska tektites were uncontaminated by extraterrestrial substances
(B) Tunguska had been the site of an earlier meteorite collision
(C) it was an extraterrestrial object that exploded above Tunguska
(D) normal tektites became deformed as a result of the impact of the Tunguska meteorite
(E) the effects of the Tunguska event were widespread

28 The author's conclusion at the end of the passage would be most directly supported by additional information concerning

(A) what quantity of cosmic dust routinely enters the Earth's atmosphere
(B) how an exploding meteor could generate conventional tektites
(C) why experts did not visit the forest until nineteen years after the explosion
(D) where and when the effect of the blast first registered on a seismograph
(E) why a large meteor would explode in the Earth's atmosphere rather than strike the Earth's surface

29 The author uses the example of the Tunguska event primarily to illustrate the

(A) origin and significance of tektites
(B) devastation caused when a meteorite strikes the surface of the Earth
(C) difference between collisions involving comets and those involving meteorites
(D) potential of the Earth's being struck by large extraterrestrial objects
(E) range of scientific theories advanced to explain an uncommon event

30 In maintaining that the Tunguska event was caused by a meteor, the author has assumed all of the following EXCEPT:

(A) The explosion was so destructive that only tiny fragments of the meteor survived.
(B) The altitude of the explosion accounts for the absence of a crater on the ground.
(C) The tektites found in the soil at Tunguska were formed by the 1908 event and not by an earlier event.
(D) The meteor that exploded near Tunguska is the largest one to have come close to the Earth.
(E) The Earth can be involved in collisions with a variety of cosmic objects.

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST. **STOP**

Section 5

5 5 5 5 5

Time-15 Minutes — For each question in this section, select the best answer from among the choices given and
13 Questions fill in the corresponding oval on the answer sheet.

The two passages below are followed by questions based on their content and on the relationship between the two passages. Answer the questions on the basis of what is stated or implied in the passages and in any introductory material that may be provided.

Questions 1-13 are based on the following passages.

The following passages, written in the twentieth century, present two views of the architectural design of cities. Passage 1 discusses English "garden cities," planned medium-sized cities containing residential, commercial, and open space. Passage 2 offers a critique of modern cities.

Passage 1

Attempts have been made by architectural writers to discredit the garden cities on the ground that they lack "urbanity." Because the buildings in them are generously spaced and interspersed with gardens, lawns, and trees, they rarely produce the particular effect of absolute enclosure or packed picturesqueness not undeservedly admired by visitors to many ancient cities. This is true; garden cities exhibit another and a more popular kind of beauty, as well as a healthier and more convenient form of layout.

But the garden city is, nonetheless, truly a "city." The criticism exposes the confusion and aesthetic narrow-mindedness of the critics. If the word "urbanity" is used in the accepted sense of "educated tastefulness," the charge that the garden cities are without it is an affront to the well-qualified architects who have taken part in their design. If it is used in the simple etymological sense of "city-ness," the users unknowingly expose their crass ignorance of the infinite diversity that the world's cities display. And if it is used (illegitimately) as a synonym for high urban density or crowdedness, it stands for a quality most city dwellers regard as something to escape from if they can. The word "urbanity" has been so maltreated that it should now be eliminated from town planning discussions.

Tastes differ in architectural styles as they do in all the arts, and the ability to judge is complicated by changes in fashion, to which critics of the arts seem more subject than people in general. Persons vary in stability of taste: for some a thing of beauty is a joy forever, for others a joy till next month's issue of an architectural periodical.

The garden cities have been obedient to the prevailing architectural fashion. Luckily for the profession, average Britons, though not highly sensitive to architectural design, do not mind it, so long as the things they really care about in a house or a town are attended to. They take great pleasure in grass, trees, and flowers, with which the garden cities are well endowed. The outlook from their windows is more important to them than the look of their dwellings from the street. And though they would have preferred their dwellings to have some element of individuality, they accept harmonious design and grouping without resentment. Thus, given due respect for their major interest, a pleasing ensemble is attainable.

Passage 2

To the visually trained person today, the architecture of the modern city is a remorseless and unremitting assault on the senses. This kind of urban anarchy is an outstanding fact of modern life, an expression of brutalism as harsh and as significant as modern warfare. Our cities are neither expressions of civilization nor creators of civilized individuals.

We see this rampant ugliness not only in the crumbling hearts of older American cities, but in America's most modern urban areas as well—the tangle of superhighways that seem to strangle certain West Coast cities or in suburbs that project the image of a standardized, anonymous, dehumanized person. Nor have we escaped this gloomy catalog when we visit cities that have erected "good taste" into an inoffensive—but equally repugnant because false—urban "style." Urban uglification is not limited to any single country: the posters in the travel agent's office promise famous monuments and picturesque antiquities, but when you look through your hotel room window you see smog, unsanitary streets, and neighborhoods ruined by rapacious speculation in land and buildings.

Those who do not reject modern cities are conditioned not to see, hear, feel, smell, or sense them as they are. The greatest obstacle to seemly cities has become our low expectations, a direct result of our having become habituated to the present environment

Section 5

5 5 5 5 5

and our incapacity to conceive of any better alternative. Those of us who have made this adjustment are permanently disabled in the use of our senses, brutalized victims of the modern city.

We can get at what's wrong with a city like Washington D.C. by considering the question once asked seriously by a European visitor, "Where can you take a walk?" He didn't mean an arduous hike, but a stroll along a city street where you can see the people, admire the buildings, inspect the goods, and learn about life in the process.

Perhaps we need a simple litmus-paper test of the good city. Who lives there? Where is the center? What do you do when you get there? A successful urban design involves urbanity, the quality the garden city forgot. It is found in plazas and squares, in boulevards and promenades. It can be found in Rome's railroad station. When you find it, never let it go. It is the hardest thing to create anew.

1 In line 4, the word "generously" most nearly means

(A) charitably
(B) helpfully
(C) unselfishly
(D) widely
(E) benevolently

2 The author of Passage 1 objects to using the "simple etymological sense" (line 18) of the word "urbanity" for which reason?

(A) Different individuals value different aspects of urban life.
(B) The traditional idea of what is desirable in a city changes greatly over time.
(C) Discovering the history of a word is often difficult.
(D) Not all of the world's cities are alike.
(E) It is dangerous to disregard the opinion of experts.

3 In Passage 1, the reference to "next month's issue of an architectural periodical" (lines 31-32) serves to

(A) show that the plans for the garden cities are well thought of in professional journals
(B) indicate that what seems like a random process is actually an ordered process
(C) suggest that some people lack their own firm ideals of beauty
(D) imply that only those who are knowledgeable about a subject should offer their opinions
(E) emphasize the importance of what the experts say

4 In lines 34-41, by considering the relative importance to "average Britons" of the view from their homes, the author of Passage 1 suggests that

(A) natural light is an important element of urban design
(B) Britons are not particularly concerned about the architectural design elements that catch the attention of critics
(C) the appeal of grass, trees, and flowers has been overrated by many architectural theorists
(D) the importance of designing buildings that have a pleasing exterior form needs to be remembered
(E) Britons often object to being treated like members of a group rather than like individuals

5 In the last paragraph of Passage 1, the author acknowledges which flaw in the design of the garden city?

(A) The uniformity of the dwellings
(B) The view from many of the windows
(C) The constraint imposed by the landscape
(D) The emphasis placed on plantings
(E) The outmodedness of the architecture

Section 5

5 5 5 5 5

6 The references in Passage 2 to "posters" (line 64) and the view from the "hotel room window" (line 66) serve to

(A) give an accurate sense of the two places
(B) highlight the distinction between the ideal and the reality
(C) show what could be, as opposed to what is
(D) criticize those who would say negative things about well-loved places
(E) invoke past splendor in order to point out present flaws

7 In line 68, the phrase "rapacious speculation" refers to

(A) rapid calculations
(B) endless deliberation
(C) immoral thoughts
(D) exploitative investments
(E) illegal gambling

8 If modern cities are so terrible, why, according to Passage 2, do people continue to live in them?

(A) Cities provide more varied employment opportunities than other places.
(B) People see cities for what they are and actually enjoy living in such places.
(C) The cultural opportunities available in cities are more varied than those in rural areas.
(D) Despite their drawbacks, cities have a quality of life that makes them desirable as places to live.
(E) As a consequence of living in cities, people have become unable to think objectively about their environment.

9 The distinction made in Passage 2 between a "walk" and a "hike" (lines 81-84) can best be summarized as which of the following?

(A) The first is primarily a social experience, the second primarily exercise.
(B) The first involves a greater degree of physical exercise than the second.
(C) The first is more likely to be regimented than the second.
(D) The first covers a greater distance than the second.
(E) The first is a popular activity, the second appeals only to a small group.

10 The questions in lines 86-87 chiefly serve to

(A) ask the reader to compare his or her experience with the author's
(B) show that it is easier to point out problems than to find solutions
(C) suggest what the author's definition of urbanity might involve
(D) answer the charges made by the author's critics
(E) outline an area in which further investigation is needed

11 In lines 87-88, the author of Passage 2 is critical of garden cities primarily because

(A) they are too crowded
(B) they lack that quality essential to a good city
(C) their design has not been carried out rationally
(D) people cannot readily accommodate themselves to living in them
(E) they are better places for plants than for people

12 The author of Passage 1 would most likely react to the characterization of garden cities presented in lines 87-88 by pointing out that

(A) recent research has shown the inadequacy of this characterization
(B) the facts of urban life support this characterization
(C) this characterization is dismissed by most authorities
(D) this characterization is neither accurate nor well defined
(E) this characterization expresses poor taste

13 How would the author of Passage 1 respond to the way the author of Passage 2 uses the word "urbanity" to describe the quality found in "Rome's railroad station" (line 90)?

(A) The quality is not to be found in so common a structure as a railroad station.
(B) The word "urbanity" is being used to denigrate an otherwise positive quality.
(C) The word "urbanity" has been so misused as to be no longer meaningful.
(D) "Urbanity" is, in fact, one of the leading characteristics of the garden city.
(E) It is a sign of arrogance to refuse to value this quality.

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST. **STOP**

Answer Key

Section 1 VERBAL	Section 2 MATHEMATICAL	Section 3 VERBAL	Section 4 MATHEMATICAL	Section 5 VERBAL	Section 6 MATHEMATICAL
1. B	1. D	1. C	1. B	1. D	1. C
2. E	2. E	2. E	2. C	2. D	2. E
3. C	3. E	3. D	3. A	3. C	3. E
4. B	4. A	4. B	4. B	4. B	4. A
5. E	5. C	5. C	5. D	5. A	5. B
6. A	6. A	6. D	6. C	6. B	6. A
7. E	7. E	7. B	7. A	7. D	7. D
8. D	8. C	8. E	8. B	8. E	8. A
9. B	9. C	9. A	9. C	9. A	9. B
10. A	10. B	10. E	10. D	10. C	10. B
11. E	11. B	11. C	11. A	11. B	
12. A	12. C	12. D	12. D	12. D	
13. C	13. C	13. C	13. B	13. C	
14. C	14. D	14. E	14. B		
15. B	15. C	15. E	15. D		
16. D	16. E	16. B	16. 10		
17. A	17. A	17. E	17. 5.40		
18. C	18. B	18. C	18. 35		
19. C	19. D	19. B	19. 81		
20. D	20. A	20. D	20.*1/5 < x < 1/4 or .200 < x < .250		
21. E	21. D	21. E	21. 2200		
22. E	22. A	22. A	22. 7/11 or .636		
23. C	23. C	23. E	23. 96		
24. B	24. E	24. B	24. 5		
25. A	25. B	25. C	25. 9/2 or 4.5		
26. B		26. E			
27. C		27. C			
28. E		28. A			
29. D		29. D			
30. D		30. A			
		31. D			
		32. B			
		33. E			
		34. C			
		35. D			

* There is more than one correct answer to mathematics question 20. In this question, 1/5 < x < 1/4 means that the answer, represented by x, can be any value between 1/5 and 1/4 that can be gridded

Appendix E
Voluntary Participation and Liability Release Form

VOLUNTARY PARTICIPATION AND LIABILITY RELEASE FORM

I,_____, hereby

(print name)

certify that I am voluntarily participating in this research study. Additionally, I state that I am aware that I may cancel my participation in the study at any time. I release the researcher,

Lone Romagosa, as well as Montana State University from any liability in connection with my participation in this study.

_____ _____

(signature) (date)

Appendix F

Post-experimental Debriefing

April 19, 1996

Dear Subject,

Thank you for having participated in the reading comprehension experiment by taking the SAT test. If you selected to receive your score, it will be enclosed with this letter on a separate piece of paper.

In doing the research it was necessary to mask the actual purpose of the experiment. For this reason, you were told that the main purpose of the test was to examine gender differences in reading comprehension. Actually, the project was concerned with the effect of sound in an office work environment, and it was designed to determine how office workers react to various types of noise and music.

If you chose to receive the general results of the study, these will be mailed to you at a later date under separate cover.

I am conducted this study as part of my program for a Master of Science degree in Business Education and I appreciate your help in completing this study.

Sincerely,

Lone Romagosa
MSU Graduate Student

Appendix G
Cover Letter for Work Environment Questionnaire

April 19, 1996

Dear Subject,

As an office worker on our campus, you are one of 40 individuals randomly selected to participate in a research project. The project is concerned with the effect of sound in an office work environment, and it is designed to determine how office workers react to various types of noise and music. As part of the study, you are requested to fill out the enclosed brief questionnaire concerning noise and music.

All parts of the research are confidential, but if you choose, your results, as well as the general results of the study, will be mailed to you after the study is completed.

I am conducting this study as part of my program for a Master of Science degree in Business Education and I will appreciate your help in completing this study.

Sincerely,

Lone Romagosa
MSU Graduate Student

Dr. Norm Millikin
Graduate Advisor

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