THE EFFECTS OF MUSIC SOUND LEVELS

ON RESTAURANT CUSTOMER'S BEHAVIOR

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Thesis to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment
of the requirements for the degree of

Master of Science

in

Housing, Interior Design, and Resource Management

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May, 1995

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(ABSTRACT)

Restaurant attributes influence the perceptions and behaviors of restaurant customers. Among these attributes are music and its sound level. Sound level has been known to affect people's behaviors and judgments. The purpose of this study was to investigate the effects of music sound level on customers in a restaurant, specifically, where they sit and how long they stay.

The study took place in a restaurant where customers seat themselves and music sound levels vary across tables. A convenience sample of dinner customers were observed for three weeks. Each week, speakers were placed in different locations causing tables that were originally quiet to become loud.

A total of 107 table selections were analyzed using Chi Square tests. The effects of sound levels on length of stay were analyzed using an ANOVA with 36 dining parties.

The results showed no significant effect regarding table selection except when speakers were in their usual locations. An explanation of this significant effect may be that regular customers were familiar with the speaker locations

and the sound levels of restaurant tables, and therefore, chose tables with lower sound levels over tables with high sound levels. Results from the ANOVA show that the length of stay of customers at high volume tables was significantly less than at other tables. Also, there was a negative correlation between length of stay and sound levels, indicating that the louder the music the earlier customers would leave.

These findings may indicate that as customers become familiar with a restaurant's sound levels, tables with high sound levels may be avoided. Also, in high music levels customer leave sooner. The implications may be increasing or decreasing table turns or affecting the satisfaction of regular customers.

Acknowledgments

There are several people I would like to thank who helped me with this thesis. First, many thanks to Dr. Anna for all the support and patience she has given me through this research and my entire graduate career. She has been and continues to be an important mentor to me. Secondly, I would like to thank the rest of my committee. Thanks to Dr. Kark for all her help regarding the behavioral science and the acoustic input. Her assistance and good, honest nature are appreciated. Thanks to Tom Long for his help with the hospitality aspects of this research.

There are others in the college that warrant further thanks. For instance, HIDM faculty, staff, and graduate students deserve recognition, with a special thanks to Elizabeth, who was there to answer questions regarding thesis requirements and statistics. Nor can I forget Muzzo (in HTM), who gave me encouragement and direction toward my theoretical model.

I would like to thank Kevin Long, for allowing me to do research at his restaurant, for all his helpful suggestions, and for not minding the inconvenience. Thanks to all the staff: Harv, Mary Ann, Skippy (Steve), Mark, Jen, Stephanie, Cara, Carlie, and Ji. Thanks to all the prep-staff and the guys in the kitchen for turning their music off while I blasted static throughout the restaurant.

I also appreciate the help from the salesman at Holdren's, John, who loaned the speakers for the experiment. Thanks to the Mechanical Engineering department for loaning the sound meter.

Lastly, I need to thank all my friends and family for all their support. Most importantly, I must thank my very best friend and fiancée, James Carneal. Not only did he help me with the acoustical science, but he was there for me every day, listening and giving support for each new revelation and stressed out moment. I thank him for loving me during this whole experience.

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Chapter I. Introduction

The food service industry anticipated a 2% growth during 1994. In this industry, restaurants are the primary contributor toward sales that reach over $280 billion (Bertagnoli, 1994). Much of that growth is due to a competitive market and an emerging hospitality concept which involves more than providing good food at a reasonable price. Restaurants now attempt to make all aspects of the dining experience, including the interior atmosphere, more satisfying (Bartlett, 1993). The reason is that restaurants are recreational and social settings as well as places to eat. Business meetings, dates, talking with friends, reading the newspaper, and convenience are all reasons for going to a restaurant (Rettinger, 1973). Competition between restaurants is high because these activities may occur in a number of places such as offices, homes, and parks, and, consequently, restaurants must compete against other environments as well as other restaurants.

One reason customers go to a particular restaurant is that they receive benefits from visiting the restaurant. Benefits such as products, services, and attributes contribute to an overall perception which influences customer behavior (Lewis, 1984). For example, food type and quality are perceived as product benefits. Service benefits include type of service (fast food, table-side, drive thru, etc.) and a friendly, attentive wait staff. Benefits derived from exterior attributes include environmental preferences such as location and parking. Inside the restaurant, attributes convey the atmosphere and uniqueness associated with the restaurant concept, which may be lively or private, high end

or casual, metropolitan or rustic, and so forth. Attributes that communicate the restaurant concept include the furnishings, fixtures, layout, lighting, and the music or sounds heard inside.

The sound character of a room conveys information about that space and the behaviors that occur. The style of music helps to convey the concept of a particular restaurant. For example, a Mexican restaurant will typically play different music than an Italian restaurant. In addition to the style of music being played, other sound qualities also influence the atmosphere in the restaurant. The hushed ambiance and refined sounds in a fine dining restaurant are very different from a bistro where a jovial, more lively atmosphere is heard (Wagner & Paoletti, 1987). This difference in atmosphere affects behavior. One may be more likely to give a loud laugh in a bistro instead of a quieter laugh in a fine dining restaurant. Likewise, music style and tempo also affect behaviors, such as drinking rate (Schaefer, 1989).

Although sound is important in creating atmosphere, the acoustic environment is seldom regarded as a design priority in restaurants. For example, a high end restaurant in Hollywood that spent over $100,000 for redecoration failed to address the objectionably high noise generated by the air-conditioning system (Rettinger, 1973). In many restaurants, the music is responsible for high noise conditions (Wagner, 1991). Restaurants rarely balance the music levels and conversation levels, which results in yelling or ear straining.

Interior spaces that are too quiet can be just as disturbing as those that are too noisy (Kryter, 1967). When a noise is made in a quiet environment, it will be more perceptible and/or annoying than in an environment with louder

background sounds. A single distracting noise can be bothersome for a customer while eating or talking, and the noise from the customers themselves may be unnerving as attention is drawn to them. Hence, music can be used to mask disturbing sounds in a restaurant, such as customer conversation and kitchen noise. At the same time, in a noisy restaurant where music levels may be higher, it may be difficult to relax or hold conversation.

Statement of Problem

Restaurant and club type settings use music to communicate a theme and attract customers. Yet, the effects of ambient music sound levels on behaviors of restaurant customers has not been documented.

Research Objective

The objective of this study is to evaluate customers behaviors in a restaurant as sound levels of music are manipulated. Specifically, the relationship between table selection, length of stay, and music level will be evaluated.

Justifications for Study

Several groups may benefit from the results of this study.

- Because the effects of music sound levels on restaurant customers is not known, this study will expand the body of knowledge across various disciplines including interior design, restaurant management, and acoustical applications.
- Both restaurant managers and customers could benefit from optimizing sound levels. Customers may be better satisfied, creating more repeat and word-of-mouth business, leading to increased sales and, consequently, restaurant profits.

- Designers of restaurants and sound systems may become more aware of the significance of sound on people in restaurant environments, thereby producing designs of effective spaces and systems that distribute and control sounds to create a desirable acoustic environment.
- The results of this study may expand the knowledge base concerning the relationship between sound level and behavior. Since social interaction is a regular occurrence in restaurant settings, behaviors related to background noise levels may give insight to other noise related behaviors in other social settings.
- The results of this study may be used to teach design students fundamental acoustic criteria to be used in the design of restaurants and other public social spaces.

Limitations of the Study

Limitations of this study occur because of variables that are difficult to isolate in a natural setting.

- The study was conducted at a restaurant in Blacksburg, Virginia, a town with one university. Generalizing the behaviors of these restaurant customers to other restaurants may not be appropriate, since clientele may vary from restaurant to restaurant.
- Observations for this study occurred during the school year while the university was in session. Seasonal trends may have a different impact on customer behaviors.
- Observations were made during dinner since a tavern setting develops after dinner and different behaviors may occur. Consequently, generalizations to other types of restaurants or bars may not be appropriate.

- A convenience sample was used for this research. Since the sample was not random, it may not be representative of a larger population.

Definition of Terms

This section includes a list of terms and definition of terms used in this study.

Decibels (dB) - A logarithmic scale for measuring sound intensity levels.

A-scale decibels (dBA) - A dB scale weighted to ignore low frequency sound energy. This scale is often used to predict human reaction to noise.

Noise Reduction Coefficient (NRC) - A number representing the sound absorption ability of a given material averaged across various frequencies.

Speech Interference Level (SIL) - A determination of the vocal effort required to maintain conversation given ambient noise levels and distance between the person talking and the person listening.

Chapter II. Review of Literature

This chapter presents literature with topics pertinent to this study. First, a theoretical model is presented which supports the framework of research. Next, behavior, restaurants, and sound level studies are discussed in relation to each other and to this project. Finally, the research questions and design for this study are summarized.

Theoretical Model

The relationship between behaviors and attributes of a product or service may be explained by a model based on consumer decision-making (Fishbein, 1967). Fishbein's model has been widely used in consumer behavior research. Originally designed for attitudinal research, this model has been modified in investigations of tourism and hospitality research of consumer intentions, such as where people will dine (Smith, 1989). In some instances, investigations have determined attributes that are desired by customers and predetermined trade-offs with other attributes, such as food quality or food price.

When an individual selects a particular product or service, behavior is determined by a combination of beliefs and the behavioral intentions of that individual. Before a product or service is rendered, a consumer will consider (a) what to do with this product/service, (b) what features or attributes are necessary or ideal, (c) and what competing products or services have to offer (Fishbein, 1967). For example, when selecting a menu item at a restaurant, a customer may consider (a) how hungry he/she is, (b) preferred foods, and (c) how a particular menu item compares to others. When all the menu items are

evaluated and compared on their attributes (portion size, food type, price, etc.), the customer will then "sum up" the attribute qualities for the menu items and make a selection.

This version of the Fishbein model may be expressed mathematically as:

$$A_j = \sum_{i=1}^{N} V_i B_{ij}$$

where:

A_j = intention to select (or the probability of selecting) any particular alternative product, j ;

V_i = importance or value of characteristic i;

B_{ij} = the degree to which alternative j provides characteristic i; (Smith, 1989).

In order to operationalize the model for this study, the attribute (i) is the appropriate music volume. The value that the customer places on i is considered as well as the ability for a given table (j) to provide this attribute (characteristic i) compared to other tables (alternative j). After analyzing various attributes, the sum of these attributes (in this case sound level) indicates the probability of selecting a particular product (table) out of a selection of alternatives. In this case, the product is one table selected from several tables in a given restaurant. How long a customer stays there may be an indicator of how satisfied he or she is with their choice.

Effects of Attributes on Restaurant Customers

Though attributes determine customer satisfaction, very few studies have examined the effects that design attributes have on customers and their

perceptions towards a restaurant. Changes in design can either be helpful or harmful to the success of a restaurant. For example, renovations to a hotel dining room were made in an effort to decrease the formality of the space and update the color scheme (Lambert & Watson, 1984). The 140-seat dining room originally had white walls, dark red carpet and crystal chandeliers. The new decor included green walls, dark green carpet, "early-American" chandeliers, and black and white plaid tablecloths. These changes decreased the lighting from 2 foot candles (fc) to .5 fc. Quantitative measurements of the space included behavioral mapping, comment card questionnaires, and amount of guest check. Qualitative measurements included customers' perception of pleasantness, comfort, and service, which were recorded before and after the renovation. Results of the study indicated that the customers found the renovated restaurant to be more pleasant, more comfortable, and perceived that service had improved, even though the service routine was unchanged and only one member was added to the staff. Importantly, the customers tended to stay longer even though service speed was unchanged.

In a separate study, the effects of a restaurant's color and atmosphere (space and lighting) on individual eating habits were investigated (Kissler, 1986). The eating habits of approximately 125 regular customers were observed in private, semi-private and open areas, as well as softly colored, brightly colored and achromatic areas. Ninety-two percent of customers preferred to sit in semi private areas, and 90% preferred softly colored areas. Customers in these areas also stayed in the restaurant longer (40 to 50 minutes) than customers in other areas 15 to 35 minutes). The amount of privacy, atmosphere, and length of stay were all factors in increasing the average guest check amount per

person. These results indicate that the more preferable the atmosphere, the longer customers stay, and the more they will spend on food and beverage.

Effects of Noise on Social Behavior

Noise is an attribute that also affects behavior. When noise levels generated by heavy, medium, and light traffic flow were examined on three streets, social interaction of the residents were affected (Appleyard & Lintell, 1972). Although other physical attributes of the streets were similar, residents of the street with "heavy" traffic flow and noise levels above 65 dB for 45% of the time had fewer social interactions with neighbors than on the other streets. Residents living on the "light" street had three times as many local friends, and two times the number of acquaintances as residents living on the "heavy" street. The "medium" street had noise levels above 65 dB 25% of the time, and the "light" street for only 5% of the time. These results indicate that social networking on each street varied as a function of noise and inversely to the sound level of each street.

The effects of louder settings on social interaction may be due to social cues and sensitivity to others. Laboratory and field experiments in which materials were dropped, seemingly by accident, under loud and quiet conditions showed that subjects were less likely to help others under loud conditions than quiet conditions (Mathews & Canon, 1975). In another experiment, when speakers placed outside classrooms and dormitories played highway noise continuously for three straight days, adverse behavioral changes in students became apparent. Subjects reported an "impairment" in sleeping, studying, social relations, general mood, conversation, concentration, judgment, alertness, and nervousness (Ward & Suedfeld, 1973). Three possible explanations for

behavioral changes due to noise may be: (1) noise acting as a stressor or (2) masking speech, thereby causing a breakdown of communications, or (3) actual disregard for others, i.e., people leave an area when noise is aversive (Jones, Chapman, & Auburn, 1981).

Interpersonal perceptions are also affected by noise. People develop ill-formed judgments of others when environmental distractions are high (Seigel & Steele, 1980). For example, when noise distraction was high (70 dB) subjects' perceptions of others became more negative. In another study, subjects played in a competitive parlor-game involving perception of group behavior. Even in a moderately loud background (75 and 61 dBA) subjects viewed others as "disagreeable, "threatening", "disorganized", and "inappropriate" (Edsell, 1976).

Music as Sound

Just as noise affects behavior, so does music. In a barroom, drinking behavior is affected by music style, rhythm, and content (Schaefer, 1989). For example, when country music is played, the slower and sadder the music, the more people drink. However, when rock or pop music is played, customers' drinking rate correlates with the rhythm and tempo, not the content (lyrics). That is, as the music tempo gets faster, people drink more. Inversely, with slower tempos, people drink less.

Music annoyance is associated with how well one enjoys the style of music, one's activities during the music, and the volume of the music. For example, music is accepted when a worker's task is interesting, satisfying, or less demanding, but becomes annoying during strenuous, more demanding work. (Nemecek, 1985).

Although music is tolerated more than other sounds at equivocal sound levels, the sounds used in these studies were generally less pleasant than music, and normally would not occur at the sound level which was tested (see Table 1; Cardozo & van Leishout, 1981; Terhardt & Stoll, 1978). In a separate study, subjects rated sixteen different sounds which included five music sounds. "Noisiness" and "loudness" of all the sounds were highly correlated although the music sounds were more acceptable (see Figure 1; Kerrick, Nagel, & Bennett, 1968). Only when music was played at a very loud volume (+20 dB) was it rated unacceptable.

Annoyance of Sound

Although individual reactions to noise may vary, some generalizations can be made about noise annoyance (Angevine, 1975). For example, differences among individuals in perceiving a sound or a sound level to be noisy are minor and insignificant when categorized by demographic variables such as age, sex, and occupation (Pearsons & Horonjeff, 1967). Generally, people seem to be more tolerant of noise if they cannot control the source, and intelligent noise, such as music and speech, is much harder to disregard than unintelligent noise (Angevine, 1975).

In order for a sound to be annoying, it must be perceived above other background noises in either sound field (Angevine, 1975). In quieter settings, an intruding noise, like shouting, will be less tolerable than in settings where there is a continuously high level of background noise. Yet, a high continuous background noise, which forces people to shout, is not necessarily acceptable (Kryter, 1967).

Table 1. Annoyance of different sound types.
Subjective annoyance evaluations of sounds with different characters. N=12.

Annoyance rank of most annoying to least annoying sound		L_AdBA art.ear
1	*Refrigerator*	*59.0*
2	*Pink noise*	*61.5*
3	*Coffee mill*	*60.4*
4	*Electric Shaver*	*61.5*
5	*Cooker hood*	*59.6*
6	*Car (braking audibly)*	*59.0*
7	*Jet plane*	*59.1*
8	*Vacuum cleaner*	*59.1*
9	*Electric typewriter*	*60.1*
10	*Baby's cry*	*59.9*
11	*Ship's horn*	*58.7*
12	*Church bells*	*57.0*
13	*Bird song*	*60.1*
14	*Fragment of music*	*58.0*

Note. Adapted from "Estimates of Annoyance of Sounds of Differenct Character" by B.L. Cardozo & R.A.J.M. van Leishout, 1981, Applied Acoustics, 14, p. 324.

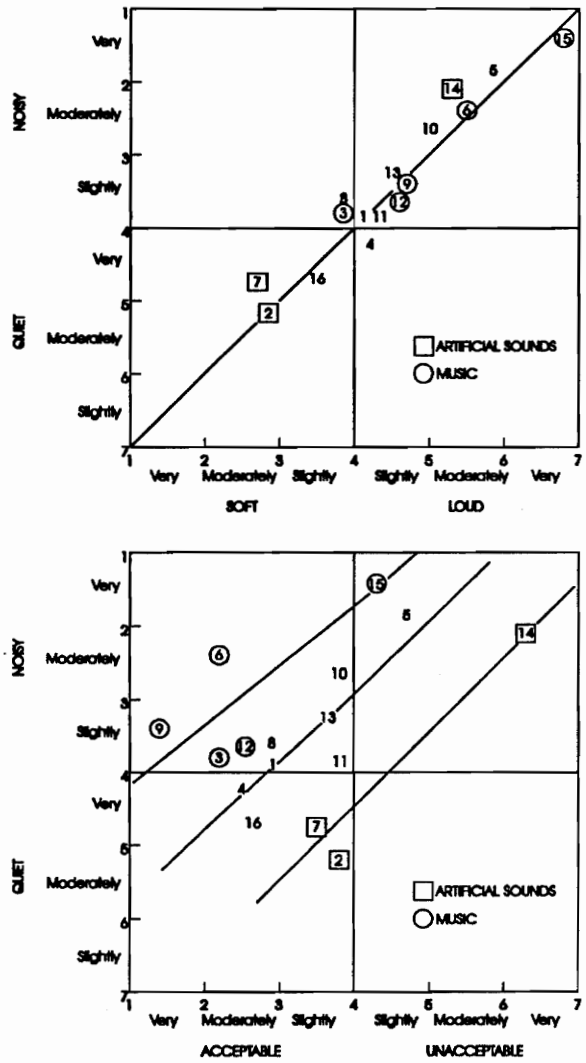


Figure 1. Noisiness of different sound types including music.
Top graph: Judgments of "noisy" versus judgments of "loud". Bottom graph: Judgments of "noisy" versus judgments of "acceptable". Sound stimuli: (1) DC8 flyover, (2) octave band centered at 1000 Hz, (3) Bernstein (jazz), (4) motorcycle passby, (5) helicopter flyover (+20 dB), (6) Popular music, (7) shaped synthetic broad-band noise, (8) auto passby, (9) folk music, (10) 720B flyover, (11) helicopter flyover, (12) Vivaldi (classical), (13)truck passby, (14) tone complex, (15) Popular music (+20 dB), (16) rain.

Note. Adapted from "Multiple Ratings of Sound Stimuli" by J.S. Kerrick, D.C. Nagel, & R.L. Bennett, 1969, Journal of the Acoustical Society of America, 45, p. 1015.

Annoyance occurs due to random or varying sounds (as opposed to unchanging sounds), higher frequencies (pitch), and increases in sound level (Cohen, 1968). Regardless of the type of sound, as it gets louder, the more annoying it becomes. At lower sound levels, annoyance is more dependent upon the type and quality of the sound, such as a squeaking chair (Berglund, Berglund, Preis, & Rankin, 1988).

Conversation and Noise

One way to investigate annoyance is through behavioral interference, such as conversation (Kryter, 1991). For example, in a study of office workers, the more important speech communications are to their job, the more bothered workers are by noise disturbances (Beranek, 1956).

In normal conversation, people speak at about 54 dB in private quarters, and about 60 dB in public spaces. Conversation is louder in public areas because of ambient noise levels and distance between the speaker and the listener (Lazarus, 1986). The amount of noise in an environment will force people to adjust their vocal efforts. This adjustment of vocal efforts is known as the Lombard effect.

Vocal efforts are generally classified as normal, raised, very loud, or shouting (see Table 2; Lazarus, 1986). For every 1 dB increase in the background sound level, there is a .5 dB increase in voice level. Men talk about 2-3 dB louder than women at normal and raised vocal efforts. At greater vocal efforts, men speak 5-7 dB louder than women (Pearsons, Bennett, & Fidell, 1977). Despite being able to talk over noise, individuals have difficulty understanding loud or shouted speech due to phonic changes. Inversely, as the

Table 2. dB levels of different vocal efforts.
Equivalent sound levels of the speaker (LSAm) at a distance of 1m from the speaker's mouth for indicated vocal effort.

Vocal Effort		**Speech level $L_{SAm,1m}$ (dB)**
Whispering		36
Soft	*Speaking*	42
Relaxed	*Speaking*	48
Relaxed, normal (p)	*Speaking*	54
Normal, raised (p)	*Speaking*	60
Raised	*Speaking*	66
Loud	*Speaking*	72
Very loud	*Speaking*	78
Shouting		84
Maximal shout		90
Maximal shout (in individual cases)		96

p, In private quarters.

Note. Adapted from "Prediction of Verbal Communication in Noise - A Review: Part 1" by H. Lazarus, 1986, Applied Acoustics, 19, p. 454.

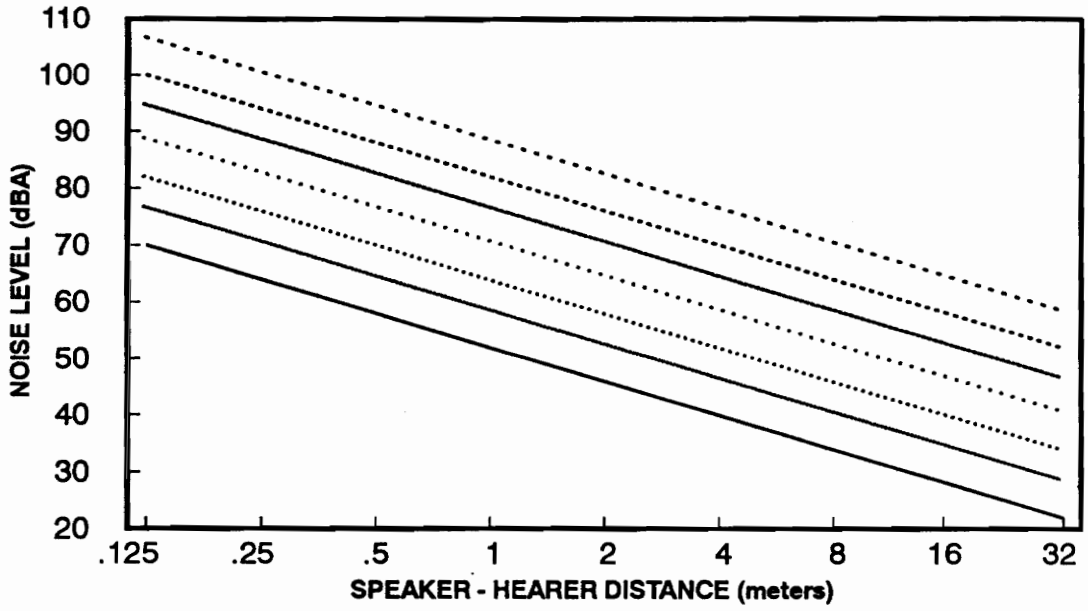
speech level decreases, the quality of verbal communication increases (see Table 3; Lazarus, 1987).

Since conversation is a regular occurrence in restaurants, it is interesting to examine how the ambient noise affects speech. Speech interference levels (SIL) against background noise and the distance from the talker to the listener were first charted by Webster (1969). SIL curves were later slightly modified by adjusting the signal-to-noise ratio to account for conversation areas. People talking at a distance of .5 m will use their normal voice at 62 dB, a raised voice at 71 dB, a loud voice at 76 dB, and a very loud voice beginning at 84 dB. It is not until 88 dB that people will begin to shout (see Figure 2; Lazarus 1987).

Studies regarding aircraft environments shed light on comfort levels and length of conversation in noise. When noise levels exceed 78 dB, passenger comfort and noise acceptance are adversely affected (Rudrapatna & Jacobson, 1976). In a related study, the effects of noise level on passenger-to-passenger speech communications were investigated (Rupf, 1977). Paired subjects who engaged in conversation for 5 minutes for each noise condition (75, 80, 85, and 90 dBA noise levels) were asked how long they could talk without vocal strain during a 2 hour trip. At 75 dBA, 50% of subjects could talk for an hour. At 85 dBA, 50% could talk only for 5 minutes (see Figure 3). These results imply that as background noise level increases, the amount of time people can converse decreases. Since the ambient noise levels of aircraft are similar to that of a busy restaurant, the effects on restaurant customers engaged in conversation may be similar to aircraft passengers.

Table 3. Vocal effort and communication.
Quality of verbal communication, dependent on the speakers effort (Speech Level Intensity $L_{SA,\ 1m}$) and on the impediment of the speaker intelligibility at the hearer's position (Extent of Signal-to-Noise Ratio L_{SNA}).

Speaking		Hearing		Verbal Communication	
$L_{SA,1m}$ (dB)	Effort	L_{SNA} (dB)	Impediment	Effort	Quality
>78	*High*	< -3	*High*	*High*	*Insufficient*
72	↑	-3...0	↑	↑	*Sufficient*
66	↑	0...3	↑	↑	*Satisfactory*
60	↑	3...9	↑	↑	*Good*
54	↑	9...18	↑	↑	*Very good*
<48	*Low*	>18	*No*	*No*	*Excellent*



SPEAKER - HEARER DISTANCE (meters)		.125	.25	.5	1	2	4	8	16	32
relaxed	———	70	64	58	52	46	40	34	28	22
normal	———	76	70	64	58	52	46	40	34	28
raised	·····	82	76	70	64	58	52	46	40	34
loud	·····	88	82	76	70	64	58	52	46	40
very loud	———	94	88	82	76	70	64	58	52	46
shouting	·····	100	94	88	82	76	70	64	58	52
max. shout	·····	106	100	94	88	82	76	70	64	58

Figure 2. SIL curves.
Vocal effort and distance between talker and listener for satisfactory speech communication as limited by ambient noise level.

Note. Adapted from "Prediction of Verbal Communication in Noise - A Development of Generalized SIL Curves and the Quality of Communication: Part 2" by H. Lazarus, 1987, Applied Acoustics, 20, p. 249.

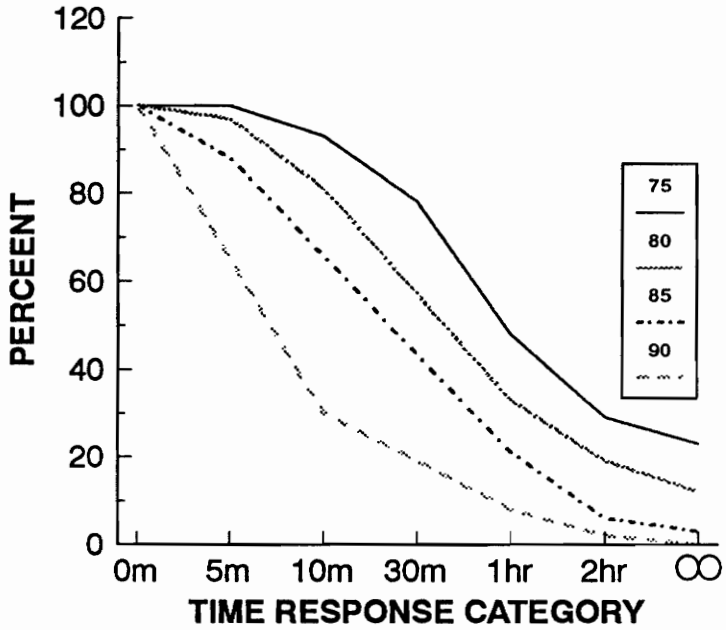


Figure 3. Length of conversation in noise.
Length of time a percentage of people would be able to talk for a given noise condition (75, 80, 85, 90 dBA).

Note. Adapted from "Noise Effects on Passenger Communication in Light Aircraft" by J.A. Rupf, 1977, Society of Automotive Engineers (Report No. 770446).

As noise affects conversation, people grow aware of the noise in their environment. In the evaluation and selection of a new residence, noise level was discovered to be a crucial factor (Paechter, Rohrmann, Wertenbroch, & Wetzel, 1988). Though costs and comforts came first, the amount of noise was the most important environmental attribute in home selection. If people use noise to discriminate in their residences, they may also use noise to discriminate in their selection of a restaurant and where to sit within a restaurant.

Acoustical Design Considerations for Restaurants

Noise or sound may be generated by two fields of sound: the direct sound field generated directly from the source, and the reverberant sound field that is reflected from surfaces in the enclosure (Kinsler, Frey, Coppens, & Sanders, 1982). Two ways to control the direct sound field are (1) create distance from the sound source, and/or (2) quiet the sound source. Because these options are not always possible, it is usually necessary to control the reverberant sound field by using proper sound-absorbent and/or sound-reflecting surfaces (Wagner & Edwards, 1988). There are several factors that directly effect the acoustics of a space including the finishes, room shape, and room dimension. In a restaurant, further consideration should be made toward the interior design, speaker locations, and customer noise. (Wagner & Paoletti, December 1987).

Finishes

When a sound wave hits a surface, the energy from that sound wave will disperse. Some of that energy is absorbed by the surface (usually converted to heat or another type of energy), some is reflected from the surface, and some is transmitted to the other side. The amount of absorption, reflection or

transmission depends upon the angle of incidence and the type of surface. Factors that determine sound absorption of a surface include the softness of a material, porosity, flow resistance, and to a degree, thickness (Rettinger, 1973).

When a sound wave hits a surface, the amount of surface friction determines the amount of energy that is absorbed and reflected. Generally, softer materials are more likely to create surface friction when the sound wave strikes it, thereby absorbing more sound. On the other hand, hard, smooth materials are more likely to reflect a sound wave. For example, soft materials such as felt, cotton, wool, etc., are better for absorbing sound waves than hard materials such as ceramic, glass, and wood (Rettinger, 1968).

Porosity, or the ratio of voids in the volume of a material, also affects the amount of sound that is absorbed. Again there is friction as the sound resonates in the cavities near the surface. However, when there is intercommunication between the pores, the resonance in the cavities behind the exterior surface can absorb sound more effectively. This is termed flow resistance, which deals with the amount of air that can be passed through a surface. Closed pores, like plastic foams, are less sound absorbent then more penetrable ones, like fibrous material such as fiberglass (Rettinger, 1968).

In cases involving light weight panels, the fiction of a sound wave hitting the panel causes it to flex, setting it into vibration, transferring it into heat energy. Light weight panels work especially good when thickness is created by using an air space to act as a diaphragm. Examples from interiors may include double-pane windows, and doors. When the air spaces are filled with fibrous materials, there is further absorption of the sound energy (Moore, 1978).

The absorbency of common building materials and finishes can be predetermined by the absorptivity coefficient, commonly known as the Noise Rating Coefficient (NRC) which uses a scale between 0 and 1. For example, a plaster ceiling has a NRC of .05, while a suspended acoustical tile ceiling has a NRC of .95. Generally, materials with NRCs of .05 - .10 have little effect on sound absorption; .10 - .20, a significant effect; and .20 and above considerable effect (Egan, 1972). For restaurants, an overall NRC greater than .5 is preferred. This can be accomplished simply by utilizing a full ceiling treatment if the ceiling height is between 10 and 12 feet, in which case, wall treatments are not usually required. However, in restaurants where the ceiling height is greater than 12 feet, it is also necessary to also treat a portion of the walls (Suri, 1966). These general guidelines indicate that special considerations of finishes and furnishings are necessary when designing a restaurant.

Room Shape and Dimension

Just as the absorbency of the surfaces affects the amount of reflection, so does the room and ceiling shape. The primary concern with room shape is echo. Sound travels approximately 1000 feet per second. When sound reflections take longer than 60 milliseconds to reach the human ear, an echo is perceived. Generally, this often occurs in rooms that are longer than 30 feet on a main axis (Wagner & Paoletti, November 1987). Some common solutions to echo include treating the room with sound absorbing materials, tilting the walls or ceiling in order to shorten the delays in reflections, and installing diffusers or diffusing elements (Egan, 1972). The technique of diffusing sound involves controlling the reflections by means of dispersing them randomly so that no one reflection is strong enough to be annoying (see Appendix A).

Flutterecho is another type of echo that can be disturbing in interior environments. This is when a sound bounces back and forth between two hard parallel surfaces, and usually creates a "ringing" or "hollow" sound of high frequencies. For example, when parallel walls have hard surfaces, sounds will bounce between the two planes a number of times before the energy decays. One solution to flutterecho may include again using sound absorbing materials instead of hard materials. Another solution is to make the walls not parallel, though considerations should be made to not focus reflections back toward the source (see Appendix B) (Egan, 1972).

Curvilinear forms can have very bad or very good acoustics. Smooth concave walls focus sound to the center of the room, or commonly, a concave ceiling, such as a dome or a barrel vault ceiling, is even worse as all sounds are focused toward the center, making the room overly loud. This means dining tables placed in the center of a room with a concave ceiling will be uncomfortably loud. On the other hand, a convex ceiling is acoustically good since sound reflects away from the center of the space thereby diffusing the sound (see Appendix C). Likewise, variegated or coffered ceilings are very good for diffusing sound. The more variegations or the deeper the coffer, the better the sound will be diffused (Wagner & Paoletti, November 1987).

Circular rooms not only focus sound toward the center of the room, but also have another problem concerning speech privacy. In circular rooms, a sound may be reflected around the perimeter of the room. This phenomena is known as creep. If only hard materials are used, a conversation in the room would literally "creep" around the circumference of the room till people could hear it on the opposite side of the room (see Appendix C)(Egan, 1972). Similar

problems take place in rectangular rooms, especially when large planes of glass, such as mirrors or windows, are present. Glass can be more problemsome than other hard materials because of its high sound reflecting properties. Large glass planes will transmit conversations along the length of the glass. For example, in a restaurant, when seating is along a windowed or mirrored wall, a conversation could be heard from one table to the next. For both room shapes, circular or rectangular, one solution for maintaining speech privacy is to place acoustical mini-partitions six to 12 inches wide perpendicular to the wall approximately every four feet. These mini-partitions will help the intercept the reverberant sound (Wagner & Paoletti, December 1987).

Speaker Placement

Speakers are best heard if the sounds reach the listener with little or no reverberation. Also, the placement of speakers in a space should be so the sounds are heard uniformly across the space by all users. In order to achieve this, a central speaker or centralized speakers are ideal, so that the sounds are evenly dispersed to all parts of the space. One may see speakers used in this fashion in coliseums or athletic arenas. However, in most spaces there is a need for additional audio support in more remotes spaces, like behind corners (Kuttruff, 1979).

In spaces with several sections, like many restaurants, a centralized speaker location is not possible. Therefore, several speakers must be used at different positions to create an uniform sound field. However, each speaker must only reach a small maximum distance, and be distributed uniformly throughout. The small maximum distance is to ensure that no space, (or in a restaurant, no dining table) will have overlapping signals from more than one

speaker. If overlapping sound is heard from a speaker, then a) the sound from the speakers are not uniformly heard as sound levels may vary with distance, b) listeners may be disturbed by hearing more than one signal at a time, and c) the intelligibility of the signal may not be clearly heard. Designers should try to place several small speakers at even intervals throughout the restaurant to establish consistent music sound levels and avoid speaker sources from becoming too loud in any given area (Kuttruff, 1979).

Restaurant Layout and Design

In a restaurant, noise is generated by the kitchen, customers' conversations, and customers' and staff's use of utensils, etc. These noises can have a cumulative effect of the amount of noise in an untreated room. According to medical authorities, noisy conditions may adversely affect the digestive system, therefore ideally, restaurants should be kept pleasantly quiet (Suri, 1966).

Restaurant kitchens and pantries can be especially loud due to equipment noise, staff communications, and crockery and utensil use. Therefore, connecting corridors between the kitchen and dining areas require sound absorbing materials to control the sound (Suri, 1966). Other external dining room sources of sound may come from the street and traffic noise. Treatment for these types of noises may include using double paned windows or a half-inch thick plate window (Rettinger, 1968). Music is often used to mask these types of intruding sounds.

Inside the dining room further considerations can be taken. As talked about earlier, the types of materials, the room shape and dimensions, and placement of the speakers all influence the acoustics of the room. For example,

a designer may use harder, more reflective materials to create a livelier environment (though caution should be used to control annoying sounds and speech privacy). At the same time, softer materials, such as carpeting, acoustic tiles, and wall upholstery will create a more subdued atmosphere (Wagner & Paoletti, December 1987).

Table size and layout influence the acoustics of a dining room. Small tables (36 inches or less) are better for controlling sound than larger tables. Larger tables distance customers, forcing them to talk louder. A larger surface area also creates louder reflections. Designers should try to avoid using large tables or at least place them in the middle of the space, away from walls and windows that may reflect sound (Wagner & Paoletti, December 1987).

The "Cocktail Party" Effect

In spaces where there are many conversations taking place at the same time, like a restaurant, a problematic situation may arise called the "cocktail party effect". This occurs when the sound level of conversations are raised to shouting due to competition. Each talker in a space will increase their vocal efforts as people begin to talk in groups. Though each talker is only trying to communicate with their own group, there is a competition of sounds from other talkers which forces each talker to speak louder. This has a cumulative effect until each talker is using their maximum vocal efforts. There are a few techniques that can be used to minimize this effect. First, use as much sound absorbing material as possible in order to decrease the reverberation in the space. Next, decrease the amount of background noise levels. This will subjectively cause early arrivals to talk quietly and thus later arrivals will not

cause voice levels to increase much higher. Thirdly, subdividing the space will cause fewer people to be heard in any one section (Lawrence, 1970).

Summary

Fishbein developed a model that may explain the relationship between restaurant attributes and customers' decisions. Among these attributes is the sound level or music volume, which if too loud, may be annoying and affect behavior. Studies have shown that as sound levels increase people become more annoyed, conversation is impaired, and people's judgments become more negative (Cohen, 1968; Edsell, 1976; Lazarus, 1987; Seigel & Steele, 1980). The effects of music sound level on customers is important since many restaurants, bars, and lounges play music. The purpose of this study was to evaluate customer behavior as a function of music volume.

Research Questions

This study investigated the following questions.

1. Does the music sound level affect customers' table choices?
2. Is there a difference in length of stay at a table as a function of sound levels?

Research Design

The study was designed to be a field experiment.

The independent variable was the sound level. Two speakers were manipulated to create loud and quiet areas. The sound levels of these areas varied as the speakers were manipulated before each condition.

Dependent variables were (1) where the customers sit, and (2) the length of time they stayed.

Chapter III. Method

This chapter describes the methodology of this study, including a description of the restaurant, its location, and the parameters for sample selection. Some of the procedural decisions in this study were made using the results of a pilot test.

Location

Criteria

Specific criteria were developed to select a restaurant for conducting this research. Because customers must choose where to sit, one criteria was to not have a host or hostess. Also, since time was a dependent variable, the length of the meal (or the service time) should not inhibit how long customers stay. Finally, because of the experimental design of the study, the ability to vary sound levels throughout the restaurant was critical.

Restaurant

The restaurant, located in the downtown area of Blacksburg, Virginia, near a large university campus, was selected for this study. Despite a large student population which is seasonal, a regular clientele has enabled the restaurant to be successful year round for the past seven years. In fact, the restaurant was so successful, a second level was added to handle additional demand. Opening at 4:00 p.m. daily allows enough preparation time to accommodate large demands for the restaurant's Greek and Italian cuisine. Before closing at 2:00 a.m., the restaurant becomes more like a tavern, thereby allowing customers to feel free to linger.

Although the restaurant has two floors, only the first floor was used in this study since acoustical qualities of the second floor are poor. However, the acoustical properties of the first floor are relatively good because of the low ceiling with acoustic ceiling tiles (NRC .95). Vinyl composition tile covers the floor (NRC .05), the lower half of the walls is plywood paneling (NRC .15) and the upper half is plaster (NRC .05). In addition, the many small tables and alcove areas help to diffuse sounds and aid in speech privacy. The layout is conducive to conversation and consists primarily of tables, chairs, and built-in benches (NRC .30; see Figure 4). The first floor has a dark atmosphere using only cove lighting and few down lights for illuminating most of the space (see Appendix D). Still, there are spaces which are sufficiently lit and private enough to accommodate activities such as reading. Music styles played by the staff are varied and include blues, rock, alternative, funk, new age, and jazz, etc.

On any given day, there are only one or two wait staff. The staff does not have preassigned tables, but rather works all tables as needed. Consequently, customers do not select tables based upon the wait staff.

Subjects

A convenience sampling method was used to select subjects. Data was collected on customers who entered between 4:00 p.m. and 7:00 p.m., Saturday - Thursday, for three consecutive weeks in February. The pilot test revealed that Friday evenings are very busy. The large numbers of people become difficult to observe and the ambient noise from other customers is increasingly loud. Because of these difficulties, observations did not take place on Friday. Since level of privacy may be a confounding variable, only semi-private spaces were

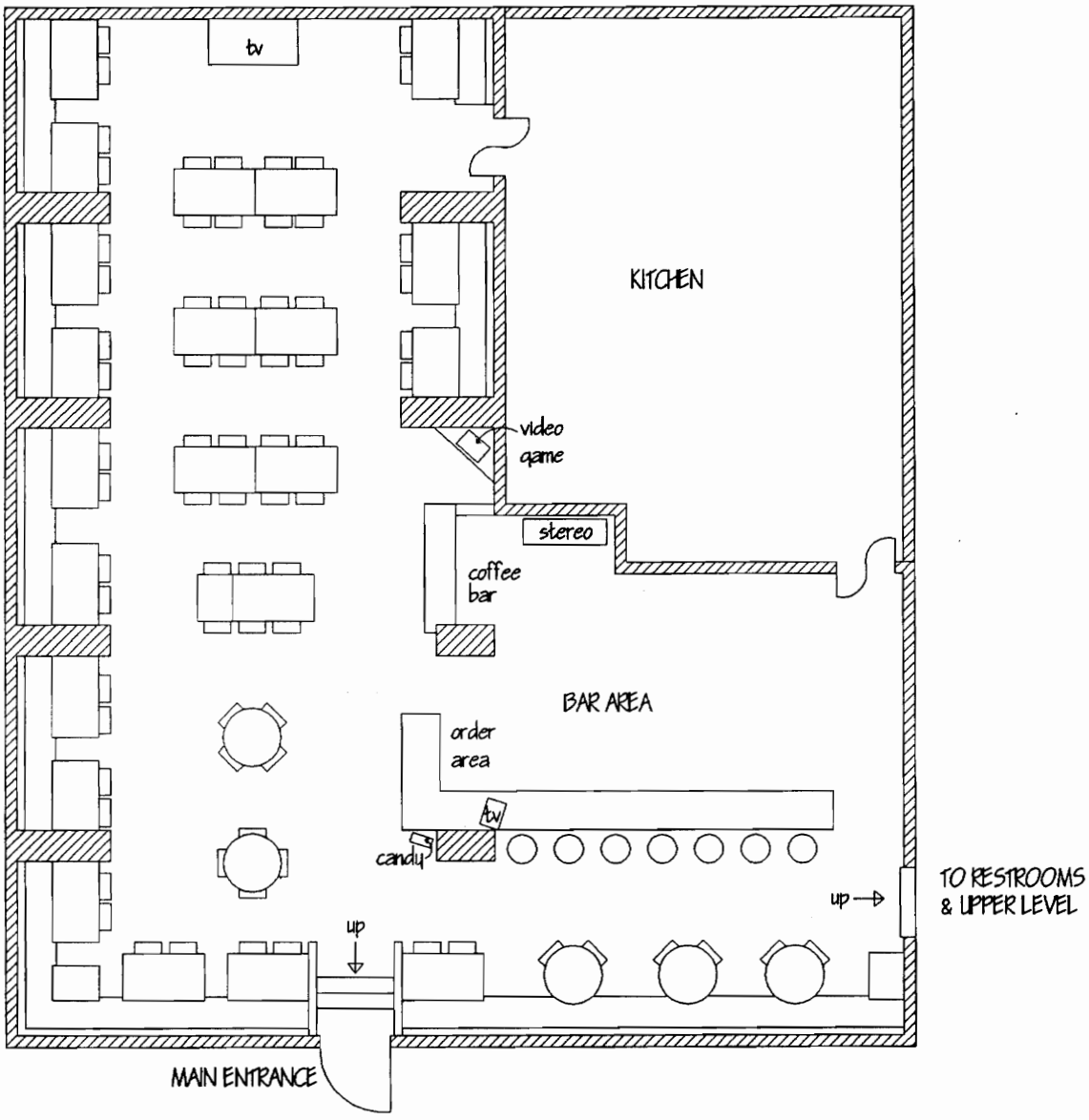


Figure 4. Restaurant floor plan.

observed (see Figure 5). Lastly, employees of the restaurant were not included in the sample.

The sample was grouped by dining party, since a table may be used by one person or several people, and often one person in a group may be responsible for selecting a table. Groups entering the restaurant when all tables in a particular sound category were occupied were not included in the sample. Customers reading or studying also were not included in the sample, since these customers seek particular lighting conditions. Finally, table 10 was excluded from analysis since it was small and not suitable for all party sizes.

In order to determine length of stay, only groups who left before 7:00 p.m. were counted. Parties with some members leaving after 7:00 p.m. were not included in the group analysis because group length of stay could not be determined.

Procedure

Three test conditions existed for this experiment. Each condition varied in regard to speaker location. That is, each week speakers were moved to new locations changing the volume of each table in each test condition (see Figure 5). Test condition A used the restaurant's speakers in their usual location. This condition was also used in the pilot test. For test condition B, new speakers were temporarily used and the original speakers were covered to imply that they were not being used. Behind the original speakers, the wires were disconnected and rerouted to the new speakers. Speaker preparation for test condition C was identical to condition B except that the speakers were in different locations. All conditions used four speakers; however, only two speakers were manipulated to create conditions B and C. This manipulation enabled tables that were originally

Figure 5. Table codes and sound levels for the three test conditions.

quiet to become loud, and loud tables to become quieter. For example, in test condition A, table 5 had a sound level of 74 dBA. However, in condition C, table 5 had a sound level of 80 dBA. Number of tables in each condition at each sound level ranged from three to four (see Table 4).

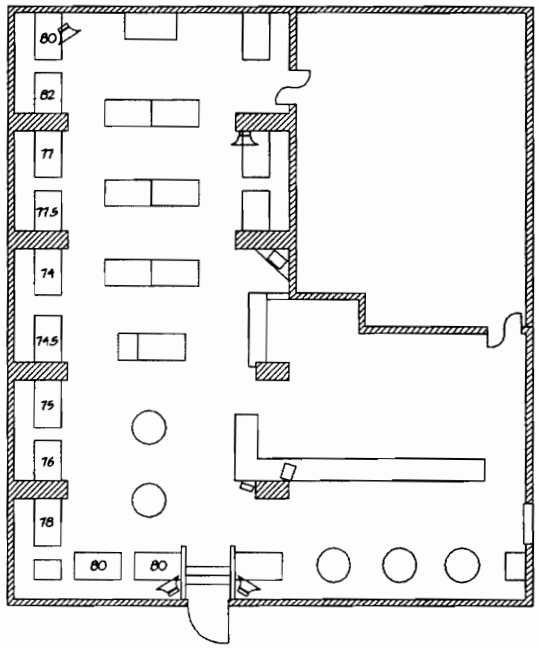
For each condition, once the speakers were in place, a recording of white noise was played. At this time, the sound level was set to 80 dBA at the "control table" located under one of the speakers. A sound level reading of each table in the study was recorded. Two other readings were also recorded, one at twice the volume (86 dBA), and another at half the volume (74 dBA; see Figures 6, 7, & 8). These additional readings helped to determine ratios of sound level fluctuations which may occur with music. That is, these readings ensured that as a song grew quiet or loud, the tables in the restaurant had similar variations in sound level despite the variation in music.

Sound measurements were in dBA. This measurement accounts for variations in human ear sensitivity as a function of frequency. Also, dBA is the simplest and most effective method for reading speech and music levels (Embleton, Dagg, Thiessen, 1959; Kryter, 1984; Olsen, Clark, & Carter, 1981; Webster, 1969).

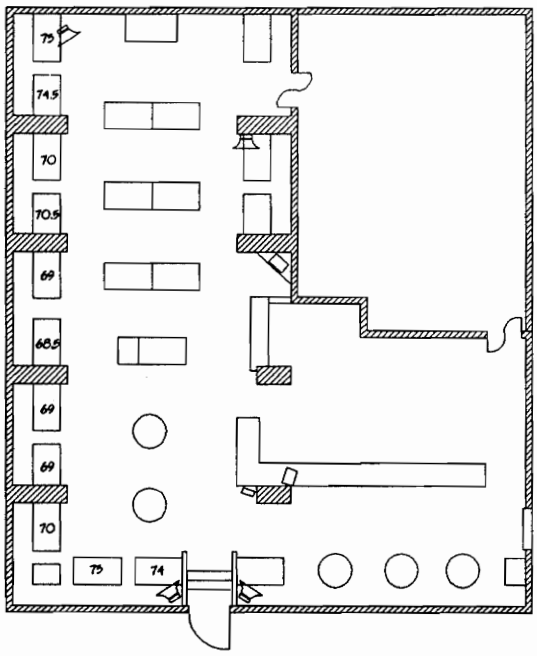
Before each observation, the lighting was set to a predetermined level which was the same in each condition (see Appendix E). Because different styles of music affect behavior differently, music selections varied across styles, thereby preventing behavior to be affected by any particular music style. Each night the staff selected the music on compact disks (CDs) to play before 7:00 p.m. Because CDs may have different input levels, each may play at different volumes. To control this effect, the CDs selected by the staff were played before

Table 4. Number of tables by test conditions and sound levels.

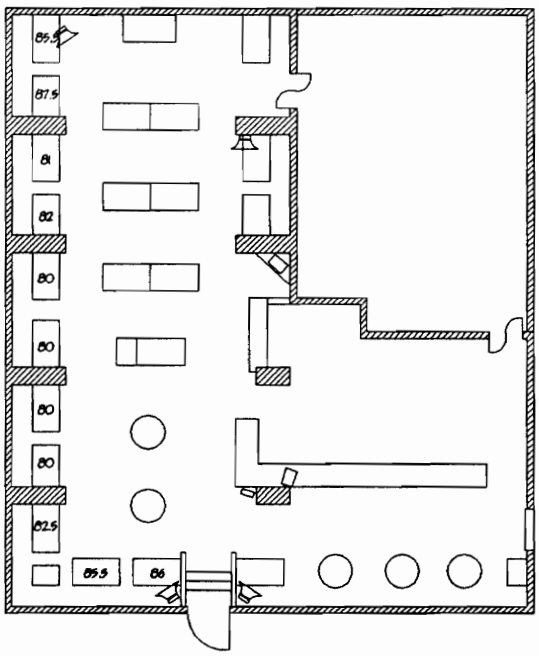
SOUND LEVEL (dBA)	TEST CONDITIONS			SOUND LEVEL TOTAL
	A	B	C	
LOW (<76)	3	3	4	10
MEDIUM (76-78)	4	4	3	11
HIGH (>78)	4	4	4	12



80 dBA



74 dBA



86 dBA

Figure 6. White noise tests for condition A.

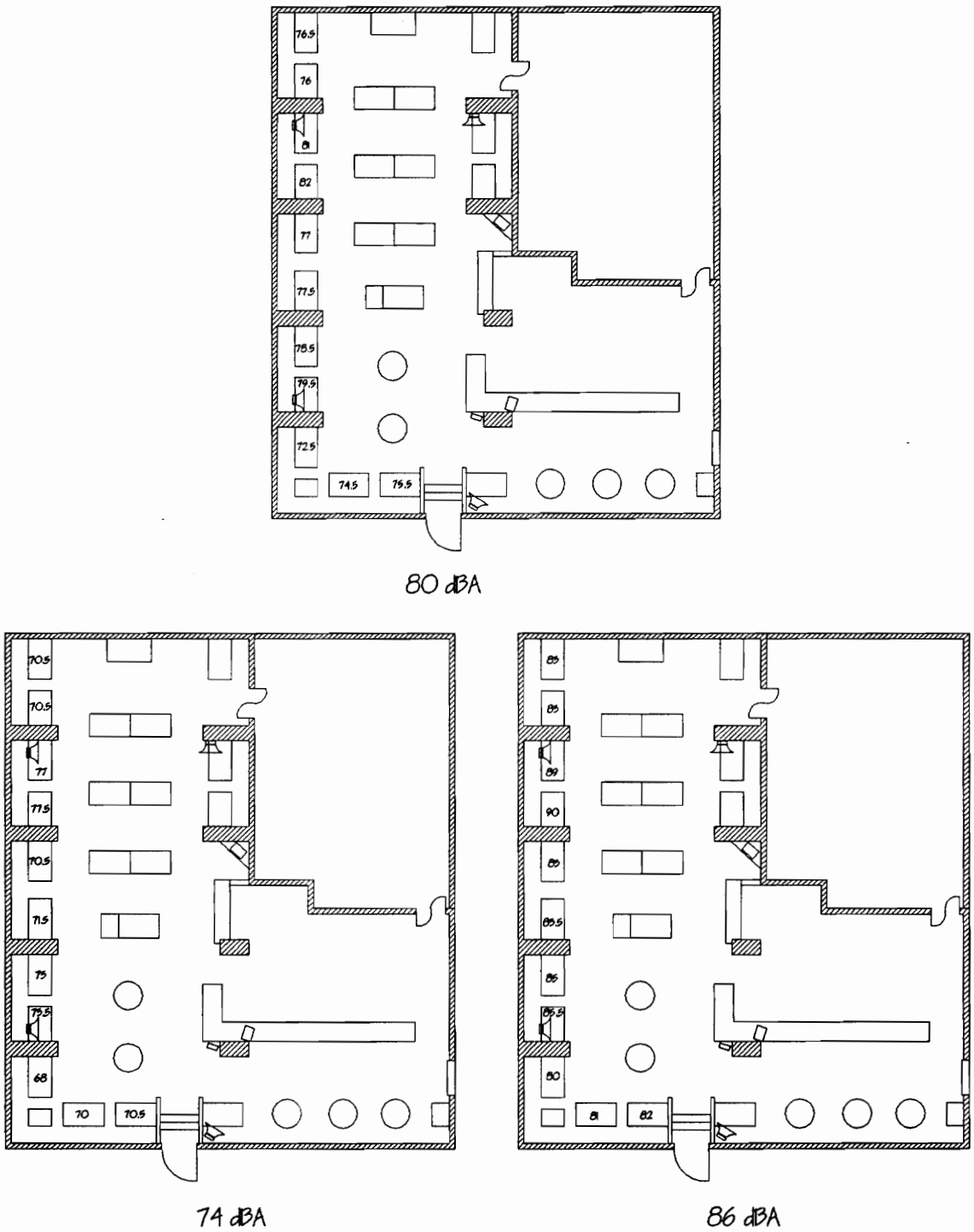


Figure 7. White noise tests for condition B.

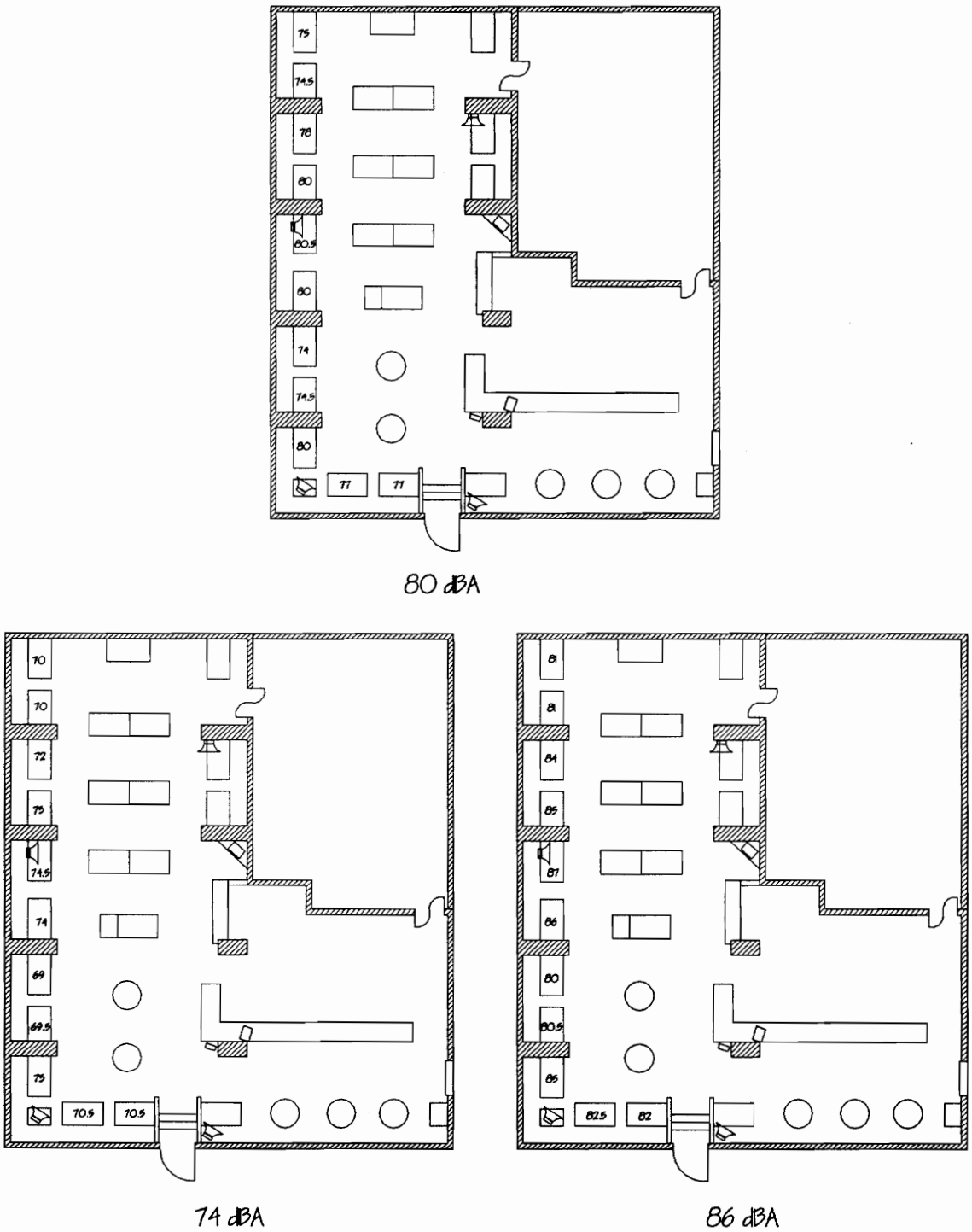


Figure 8. White noise tests for condition C.

opening the restaurant, and the sound level was set at approximately 80 dBA. At the stereo, the volume dial setting (having a numerical value) was recorded for each selected CD. Thus, when any of the selected CDs were played, the staff set the volume dial accordingly. This allowed each CD to be played at approximately the same sound level.

The observer sat at a table near the entrance in order to view the entire restaurant, including the staff, the entrance, and the stereo (see Figure 5). The observer, appearing as a customer, blended into the restaurant setting as a student studying. Thus, the observer appeared to be working on an assignment as data were collected, and stray conversation or company was discouraged. On the observation table, a sound meter was concealed in a bookbag to periodically check sound levels. As subjects entered, data was recorded on the data collection form.

Data Collection Form

No preexisting instrument was available for use in this study. Therefore, restaurant tables were coded to a floor plan (see Figure 5), and a data collection form developed and tested during the pilot test (see Appendix F). Customer behaviors were recorded in the following categories: selection of a table (table #), the time of table selection (In), and the time subjects stood up from the table to leave (Out). Gender, approximate age, eating food, number of beverages, and behaviors such as conversation or reading were recorded to better describe the sample. A comment section was also present on the data collection form to record any additional information pertinent to the study.

Chapter IV. Findings and Discussion

This chapter reports the observations of customer behaviors at the restaurant and methods of data analysis used for each research question. Included is a discussion of the results and possible explanations of the findings.

General Sample Description

A total of 267 customers were included in the sample of 107 groups. Of these, 57% were male and 43% female. Estimated customer ages ranged from 15 to 45 years. Approximately 80% of the customers were between the ages of 20 and 30 years old, and 16% between 30 and 40 years old. Over half the customers ordered food, and over 80% had 1 to 2 beverages. Most customers, 97%, engaged in conversation.

Research Question One

The first research question concerned whether people selected specific tables based on ambient music volume. Tables in the room were divided into three categories based on their noise level: low (<76 dBA), medium (76-78 dBA), and high (>78 dBA). Because of the frequency data, Chi Square tests were used to evaluate sound levels between and within each test condition. Selection frequencies are shown in Table 5. An alpha level of 0.05 was used to determine significance.

No statistically significant effect for table choices was found in a comparison of test conditions and sound levels (χ^2 (2, n = 107) = 1.56, p > .20). That is, tables were not selected discriminately by sound level. Yet in a comparison within conditions, significantly more customers chose low tables

Table 5. Sample distribution of table selection for the three sound levels and the three test conditions.

SOUND LEVEL (dBA)	TEST CONDITIONS			SOUND LEVEL TOTAL
	A	B	C	
LOW (<76)	13	12	11	36
MEDIUM (76-78)	9	17	12	38
HIGH (>78)	5	12	16	33
TOTAL	27	41	39	107

over medium or high tables in condition A (χ^2 (2, n = 27) = 6.76, p < .05). That is, in the baseline (nonmanipulated) condition, more customers chose to sit at tables with lower sound levels (<76 dBA) than tables with medium or high sound levels (≥76 dBA). This was not the case for either condition B (χ^2 (2, n = 41) = .92, p > .20) or condition C (χ^2 (2, n = 39) = 1.12, p > .20) where customers did not discriminate by sound levels when selecting a table.

Interestingly, although customers avoided the tables that were loud in condition A (n = 5), more groups chose these tables when sound levels were quieter in conditions B (n = 15) and C (n = 11) (χ^2 (2, n = 31) = 4.90, .05 < p <.10; see Table 6). No other analysis of table use approached significance.

Discussion

The results of the first research question demonstrate that customers may discriminate in table selection based on sound level. In condition A where speakers were in their usual location, significantly more customers chose the tables with low sound levels. One possible explanation of these results is that customers who may be "regulars" and are familiar with the usual sound levels across the restaurant have established behavioral patterns to avoid loud areas. Thus, despite manipulated sound levels, customers followed regular behavior patterns and chose tables regardless of sound level. This possible explanation addresses the contradiction in the nonsignificant findings with a body of literature which describes the hindrance of people's comfort and ability to converse when background sound levels increase (Lazarus, 1987; Rudrapatna & Jacobson, 1976).

The finding that more customers chose traditionally loud tables (table numbers 1, 2, 11, and 12) when they were quieter approaches statistical

Table 6. Individual table selection frequencies.

TABLE #	TEST CONDITIONS			TABLE TOTALS
	A	B	C	
1	0	1	1	2
2	2	6	3	11
3	0	1	5	6
4	5	4	4	13
5	3	6	3	12
6	5	4	4	13
7	5	3	2	10
8	1	4	5	10
9	3	4	5	12
11	1	4	3	8
12	2	4	4	10
TOTAL	27	41	39	107

LOW (< 76 dBA)	MEDIUM (76 - 78 dBA)	HIGH (> 78 dBA)

Note: Tables 1, 2, 11, & 12, the high tables in condition A, were combined in a comparison of usage by tables.

significance and may have practical significance. That is, since tables in condition A may have been chosen based on customer preference rather than sound levels tables 1, 2, 11, and 12 were regularly avoided. Customers who may not have been "regulars" were as likely to choose tables 1, 2, 11,and 12 not knowing the sound level may be high, and when the sound level was not high, remained at those tables. Sound level may have been important since customers did not leave those tables. These suggestions are speculative since the results only approach statistical significance and information regarding "regular" verses "novel" customers was not acquired.

Research Question Two

The second research question sought to determine if the ambient music volume affected how long customers stayed in the restaurant. Again the tables were divided into three categories based on their noise level: low (<76 dBA), medium (76-78 dBA), and high (>78 dBA). Due to the interval data of length of time, an Analysis of Variance (ANOVA) was used to analyze the data. Thirty-six parties that entered and left the restaurant before 7:00 p.m. were used for analysis. An alpha level of .05 was used to determine significance.

Results

The results for research question two, "is there a difference in length of stay as a function of sound levels?", indicated that there was a significant difference in length of stay between sound levels (ANOVA F-Ratio = 3.35, p = .05). A post hoc analysis, Fisher's LSD test, revealed that groups sitting at medium tables stayed significantly longer than groups at the high tables. There was no significant difference in length of stay between the low and high tables or

between the low and medium tables. Also, no significant effects between conditions and sound levels were revealed (see Table 7 & 8).

In a separate analysis, a significant relationship between sound level and length of stay was evident ($r = -.323$, $p < .05$). The negative correlation between sound level and length of stay indicates that the louder the sound level the shorter people stay.

Discussion

The results of the second research question indicate that there is a significant difference in length of stay of restaurant customers as a function of sound levels. Specifically, customers at tables with high sound levels stayed there a significantly shorter time than customers at tables with medium sound levels. One possible explanation of this outcome may be that if customers chose a table with a high sound level, they feel uncomfortable and leave. Interestingly, medium tables (76 - 78 dBA) were found to have the longest length of stay, and 78 dBA has been identified as the comfort threshold sound level (Lazarus, 1987; Rudrapatna & Jacobson, 1976). That is, sound levels greater than 78 dBA are uncomfortable to people; however, below 78 dBA sound levels are more tolerable.

In this light, the finding that people stayed longer at medium than low tables may be addressed in terns of tolerance of noise. Because music is more tolerable at higher sound levels than other noises, the medium level of music in this study may not have been viewed as annoying (Cardozo & van Leishout, 1981; Kerrick, Nagel, & Bennett, 1968; Nemeck, 1985; Terhardt & Stoll, 1978). That is, customers may have found low and medium sound levels equally

Table 7. Analysis of Variance of individual customers length of stay with sound levels and test conditions.

Source	*df*	SS	MS	F	P-value
Sound Levels	2	5198.32	2599.16	3.35	.05*
Test Conditions	2	78.35	39.18	.05	.95
Sound Levels & Test conditions	4	3824.28	956.07	1.23	.32
Error	27	20943.67	775.69		
Total	35	30993.22			

*p = .05

Table 8. Length of stay distribution (*n*), mean number of minutes ($\overline{X}$), and standard deviations (*s*) for the three sound levels and test conditions.

SOUND LEVEL		TEST CONDITIONS			SOUND LEVEL TOTAL
		A	B	C	
LOW	*n*	3	1	6	10
	$\overline{X}$	88.67	48	71	69.22
	s	16.08	27.85	11.37	8.81
MEDIUM	*n*	4	6	5	15
	$\overline{X}$	78.25	82.17	69	76.47
	s	13.93	11.37	12.46	7.19
HIGH	*n*	3	4	4	11
	$\overline{X}$	27.33	69	47.25	47.86
	s	16.08	13.93	13.93	8.40
TOTAL	*n*	10	11	15	36
	$\overline{X}$	64.75	66.39	62.42	64.52
	s	8.81	8.40	7.19	

tolerable. This concept is reinforced since there was no significant difference between the low and medium lengths of stay.

The negative correlation between the sound level and length of stay is consistent with other studies in which people leave an area when the noise becomes aversive (Jones, Chapman, & Auburn, 1981). Also, high sound levels increase people's vocal efforts, causing voice and hearing strain. Because it is difficult to talk in loud areas, conversation may be cut short (Rupf, 1977). If customers wish to have conversation but are hindered due to high music levels, they may be inclined to leave their dining table sooner than expected.

Chapter V. Conclusions

Included in this chapter is a summary and the conclusions drawn from this study. Implications of this research as well as recommendations for future study are also given.

Summary

The restaurant industry is extremely competitive; therefore, restaurants attempt to attract and satisfy customers through attributes. The Fishbein consumer decision making model states that people evaluate the attractiveness of a restaurant by its attributes. An attribute is evaluated by customers' value of that attribute and alternatives for receiving that attribute. Music is a common attribute to most restaurants and clubs. The style and sound level of the music help to communicate the restaurant concept to customers.

Sound levels may be controlled through the amount of distance between the sound source and the listener, and by the ability of the surfaces in a space to reflect or absorb noise. When sound levels increase, people become more annoyed, conversation is impaired, and people's judgments become more negative (Cohen, 1968; Edsell, 1976; Lazarus, 1987; Seigel & Steele, 1980). Though music is generally more tolerable than other sounds, at very high volumes, even music is annoying (Cardozo & van Leishout, 1981; Kerrick, Nagel, & Bennett, 1968; Nemeck, 1985; Terhardt & Stoll, 1978). Further, conversation will shorten in high noise conditions, and people may leave if they find the sound to be aversive (Jones, Chapman, & Auburn, 1981; Rupf, 1977).

The behaviors observed in this study dealt with customers' table selection and length of stay as a function of sound levels.

The study took place in a restaurant using a convenience sample. For three weeks customers were observed and data was collected on where they sat and for how long. Each week, speakers were moved to new locations changing the sound levels of each table. For example, one week a speaker was placed near a given table, causing that table to be loud. The next week that speaker may be placed far from that table, causing it to be quiet. Tables were categorized by condition and sound level (low <76 dBA, medium 76-78 dBA, and high >78 dBA).

The data for determining customer table selection was analyzed using Chi Square tests. An ANOVA was used to analyze length of stay for the three sound levels.

Conclusions

In determining if customers select tables based on sound level, there were mixed results. Even though there was no overall preference for particular tables by sound level, analysis of individual conditions indicated a preference for low sound level tables. That is, when the speakers were in their usual placement, significantly more customers chose tables with low sound levels rather than tables with high sound levels. This was not the case when speaker placement was manipulated, in that no differences in table selection as a function of sound level were evident. Interestingly, traditionally loud tables were chosen more frequently when they were not loud, although that number only approached statistical significance. These results may indicate that the behavior

of regular customers may be patterned, and that new customers require time and experience to learn which tables may have annoying sound levels.

Differences in length of stay across the three sound levels differed significantly. Groups at high tables stay significantly shorter than groups at medium tables. Though there was no significant effect found in regards to the length of stay for groups at low tables, the mean length of stay of low groups was much larger than those of high groups. The significant inverse relationship between length of stay and sound level indicate that the louder the music, the shorter the stay. These results suggest that higher sound levels (>78 dBA) may be annoying enough to decrease length of customers stay, but music sound levels up to 78 dBA are not annoying enough to cause customers to choose an alternative table.

The theoretical model used in this study allows for two possible explanations for the results in table selection across conditions: either the sound levels are not valuable to customers, or sound levels are not easily evaluated by customers. Since significant effects for sound and table choice were evident in condition A, and in the negative relationship between high sound and length of stay, an explanation that sound level is not valuable to customers may be unlikely. The nonsignificant results in table choices suggest that customer evaluation of sound levels may be difficult and that althoufh peopole may be affected by sound levels, regular attendance at the restaurant may be an overriding factor in table selection. In this study, when people were unfamiliar with the sound levels of restaurant tables, they may not have been aware that different tables had lower or higher sound levels. Consequently, customers were unprepared to evaluate tables based on noise level.

Implications

It may be that in new restaurants, since behavioral patterns have not been established by regular customers, all tables would be used by customers without acoustical bias. However, as repeat business increases, customers may be more selective in choosing a table based on sound level. This effect can decrease the productivity of these tables by not creating the profits they should be earning for the restaurant.

Importantly, 80% of the subjects in the study were between the ages of 20 and 30. Their table choices and length of stay were affected by sound level. Assuming this young population is more tolerant of loud music than older populations, the implication of satisfying an older population may mean lowering the sound level of the music even further.

Since this research has shown that music soud levels do affect peoples decisions and behaviors, there is an obligation for interior designers of restaurants to consider and manipulate the room acoustics and sound levels in order to better satisfy the end users. Successful acoustical restaurant design is possible when room shape and dimension, size and shape of tables, seating density, finishes, and speaker location are taken into consideration. In addition, restaurant owners, managers, and designers could benefit in knowing how customers are affected by the acoustical environment. If customers are more satisfied by the acoustical environment, they will be more satisfied with the entire restaurant, thereby creating a more successful restaurant.

Finally, researchers may be able to apply this acoustical research in their investigations of other social settings. This study could be an example since few acoustical studies take place in a natural or social environment.

Recommendations for Further Study

Because this was a field experiment, attempts to control extraneous variables were difficult, and changes in future investigations could provide further insight into this important area. Considerations in future research may include:

- The study could be conducted with different types of restaurants to validate results and increase generalizability. Because this study took place in a tavern, customer behaviors may vary at different types of restaurants, for example, fine dining, a bistro, etc. If the results of those studies are consistent with these results, the ability to generalize to more restaurants is much greater.
- Supplementing the experiment with a survey could be used to analyze data on customer satisfaction levels as a function of the table sound level. Rather than supposing a customer chooses a table based on sound level, survey data may indicate specific reasons why tables were chosen. Also, additional information concerning customers, such as whether they are "regulars", may give additional insight into their behavior.
- In order to avoid customer behavioral pattern bias in table selection, using a new restaurant or increase the time between observation weeks. In new restaurants, customers would be unfamiliar with speaker locations and behavioral patterns for the restaurant would not have been established. In an existing restaurant, if observations were to be spread out over several months, one could determine if in fact behavioral patterns are linked to sound levels in the space.

- The study could be repeated using lower sound levels. Just as there is a high sound level of comfort threshold (78 dBA), there may be a low sound level of comfort threshold. Restaurants that are too quiet may be just as disturbing to customers as restaurants that are too loud.
- Data on guest check totals and gratuity may be helpful in determining a relationship between sound levels, spending and tipping. Perhaps restaurant customers in lower sound levels will spend more and tip more because of greater satisfaction.
- Because most of the customers in the sample were relatively young, repeating this study using other subjects may give insight to other restaurant markets. Assuming young diners are more tolerant of loud music level, the impact on older diners may be even greater. This study could be repeated using a variety of markets, for example, the senior market, families, etc.

In this study, customer table choices and length of stay were affected by sound level. Since customer satisfaction through attributes is crucial in the restaurant business, it is important to know that sound level is an attribute that may affect customers. Very few studies of behavioral research regarding sound level in a natural interior environment exist, and very few studies regarding restaurants are documented. Therefore, the nature of this experiment makes this study and its findings important to restaurants and future acoustical studies. If more empirical research regarding restaurant environments can be performed and distributed to restaurant designers and owners, the restaurant industry may continue to increase sales as a function of successful attributes.

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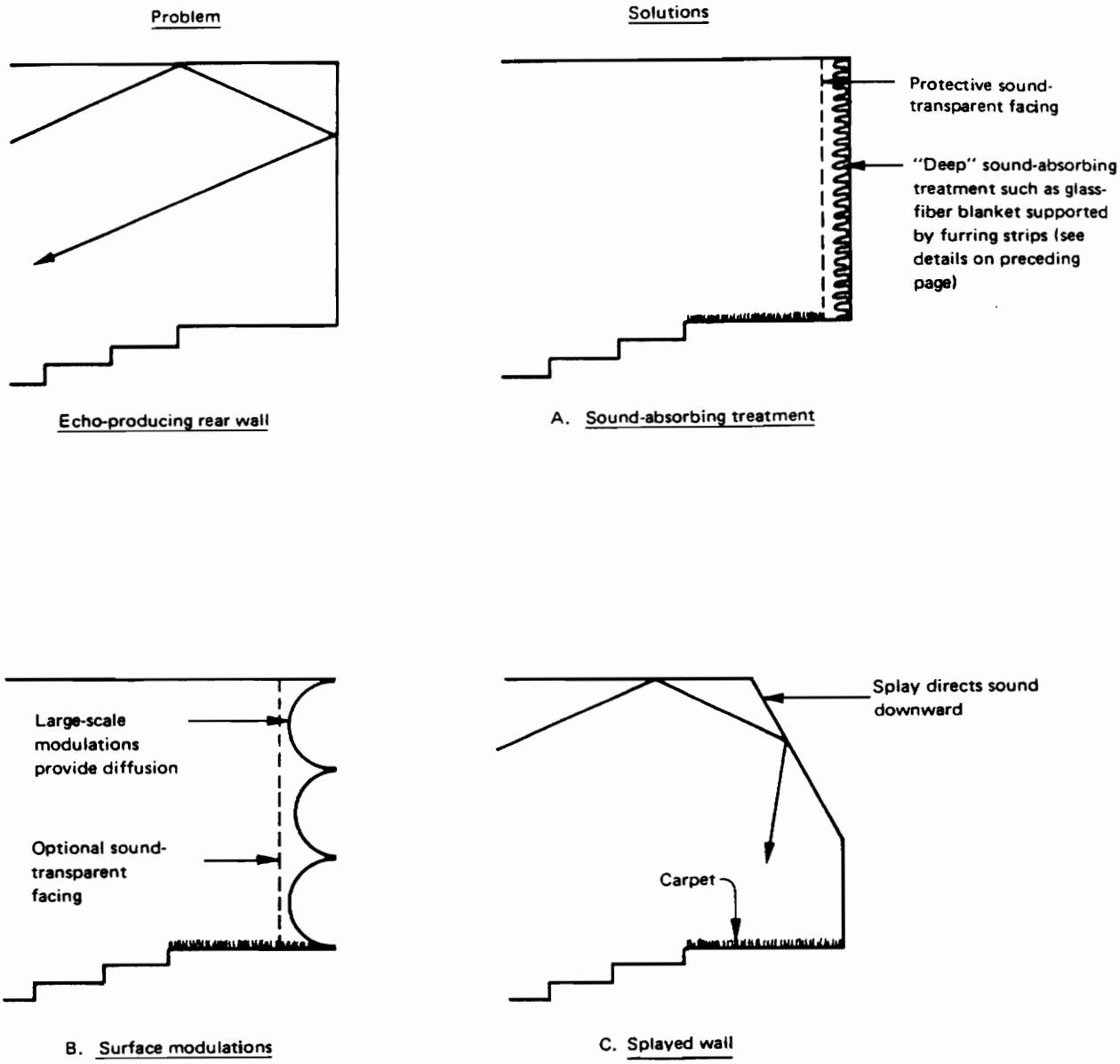
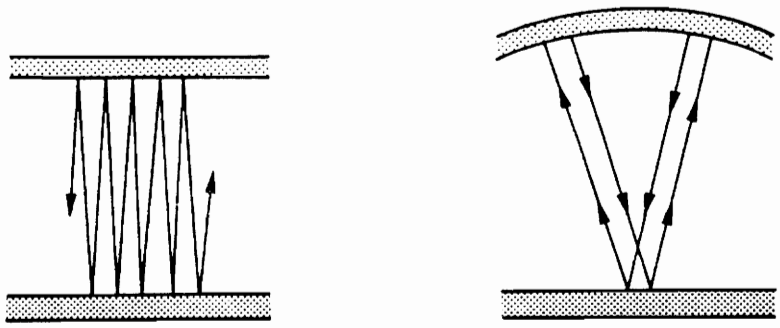
Appendices

Appendix A: Ways to Control Echo

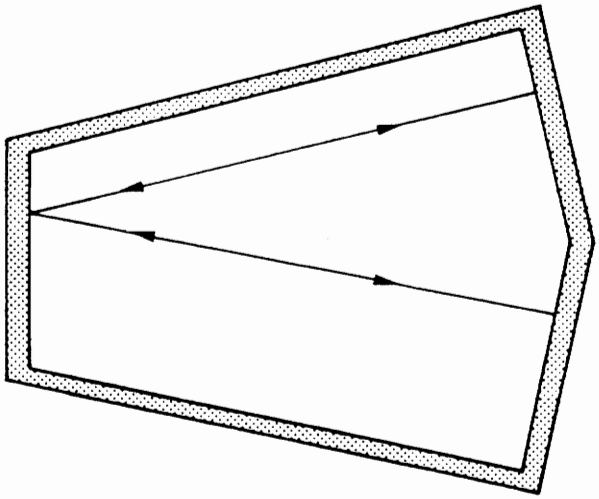


Note. From Concepts in Architectural Acoustics by M. D. Egan, 1972, p. 151. New York: McGraw-Hill.

Appendix B: Examples of Flutter Echo



Flutter echo conditions

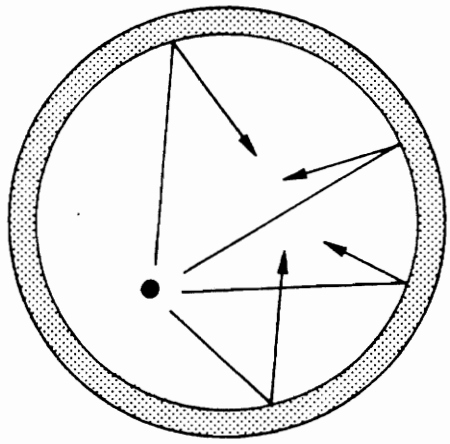


Flutter in room with nonparallel walls

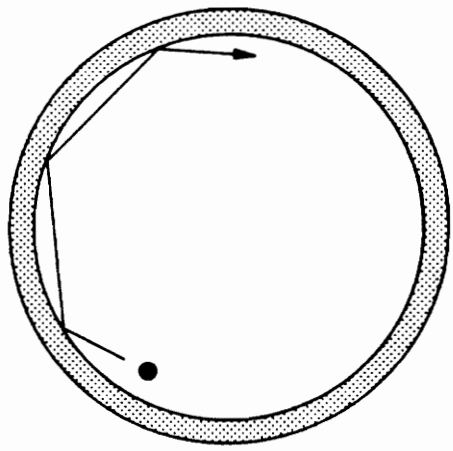
The condition shown above is called "pitched-roof flutter."

Note. From Concepts in Architectural Acoustics by M. D. Egan, 1972, p. 154. New York: McGraw-Hill.

Appendix C: Sound Reflections of Curved Forms



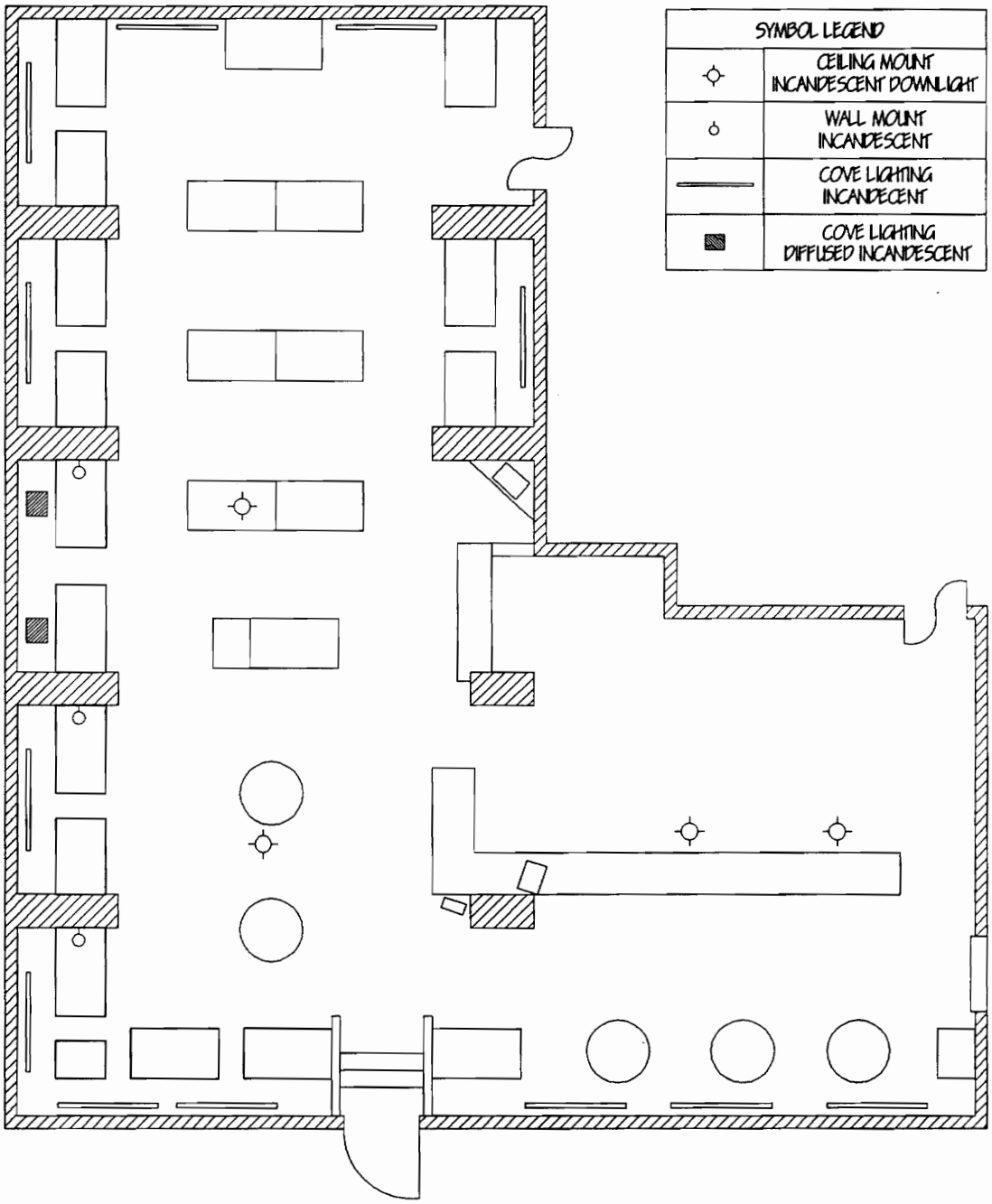
Focused sound



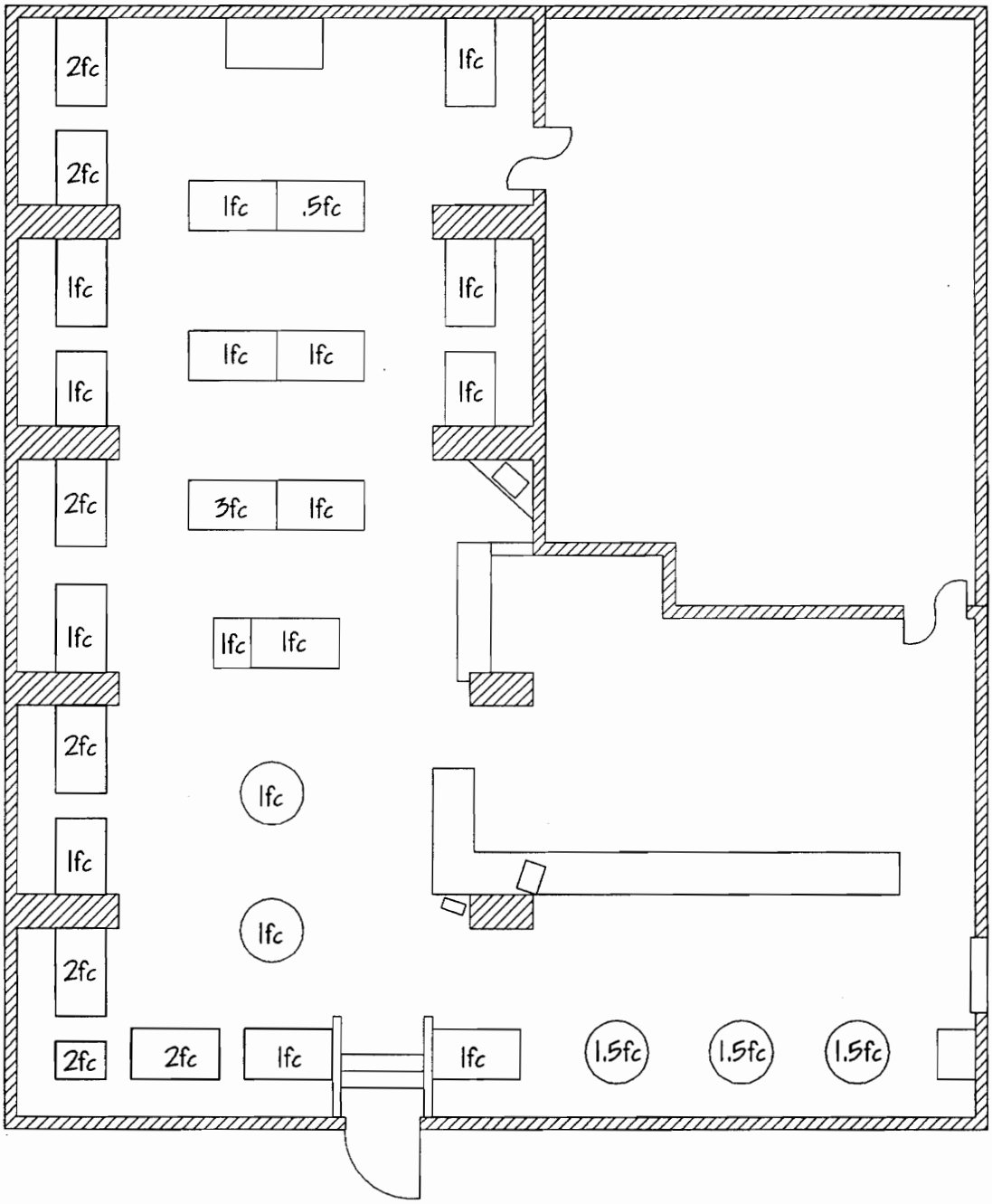
Creep

Note. From Concepts in Architectural Acoustics by M. D. Egan, 1972, p. 157. New York: McGraw-Hill.

Appendix D: Lighting Plan



Appendix E: Lighting Levels



Appendix F: Data Collection Form

Codes:

Age: 10 = 0 - 19
20 =18 - 22
25 = 23 - 27
30 = 28 - 32
35 = 33 - 37
40 = 38 - 42
45 = 43 - 47
50 = 48 - 52
etc.

Beverages: P = pitcher
w = water
s = soda

Activities: reading, conversation, other

Group #	Table #	Sex	Age	In	Out	Food	Beverages		Activities	Comments
code	code	m/f	code	0:00min	0:00min	✔	////	P	rd/conv/?	

Vita

Margaret Grace Geerdes was born on December 29, 1969 in Meriden Connecticut, and was raised in Richmond, Virginia. After graduating from St. Gertrude High School in 1987, she attended Virginia Polytechnic Institute and State University in the Interior Design Program. During this time, she was a student member of the American Society of Interior Designers and was the Special Events Chairman for the 1990-1991 school year. In may 1991, she received a Bachelor of Science degree in Interior Design.

While attending college, Margaret worked as a florist in Blacksburg, Virginia. Upon her graduation, she worked as the Floral Manager at D'Rose Flowers and Gifts. Margaret returned to school 1992 in the master's program of the Housing, Interior Design, and Resource Management. During her entire graduate career, Margaret served as a graduate teaching assistant and taught and/or assisted in several classes including Applied 2 Dimensional Design, Applied 3 Dimensional Design, AutoCAD, Presentation Techniques, and History of Interiors. With a special interest in hospitality design, she also held a job as an ABC manager throughout her graduate studies. In May 1995, she graduated with a Master of Science degree.

Currently a member of the Interior Design Educators Council, she was hired as a part-time instructor to teach Design Fundamentals I & II for the 1995-1996 school year. Future endeavors include hospitality design and teaching.

Margaret G. Geerdes