Abstract

This project was conducted to study the effects of background music on the test scores of adults in a training room setting. There has been much prior research done on this subject, yielding mixed results. Most research done so far, has dealt with school age children or college students, thus very little effort has been dedicated to adults. After a review of the literature, it was hypothesized that the playing of classical background music by the composer Mozart, would result in an increase in the test scores of adult training classes at Spirit Aerosystems Inc. A quasi-experimental test method was employed, using a two sample t test to gather the data. After analyzing the data, it was determined that although there was an increase in test scores, it was very slight and not statistically significant. Some past experiments indicate that other factors, such as lighting, temperature, and personality types, as well as different types and tempos of music, can also play a role in the creation of a successful learning environment. Due to time constraints, this study focused only on one type of music, without varying the physical environment of the classroom. It is possible that with further research, the above mentioned factors could be manipulated to produce better test scores.
Introduction and Statement of the Problem

Statement of Purpose

The purpose of this project was to determine if background music could be employed to increase the efficiency of classroom training of aircraft manufacturing employees at Spirit Aerosystems Incorporated, in Tulsa, Oklahoma. The study was conducted by playing various types of background music during the course of normal training classes. This was done from December of 2007, through March of 2008.

The study facilitator hypothesized that if a three to six percent increase in test scores could be achieved by administering background music, it would benefit the company through a better and more efficiently trained workforce. As a result, more productivity and fewer mistakes would occur.

Organizational Context

Setting of the problem. Spirit Aerosystems is a manufacturer of major components for commercial and military aircraft. It has manufacturing operations in Wichita, Kansas; Tulsa and McAlester, Oklahoma; Prestwick, Scotland; and Samelsbury, England. The Tulsa and McAlester plants operate as one, and employees approximately 2000 people combined. These two facilities, built in 1962, were originally named Rockwell International. They remained Rockwell International until 1996.
when The Boeing Company bought them. Then, in 2006, Boeing sold its Wichita, Tulsa, and McAlester plants to a Canadian conglomerate called The Onyx Corporation. These three facilities were then named Spirit Aerosystems Incorporated, and now operate as one company.

Spirit Aerosystems is controlled by a three-level senior management structure. (See Figure 1)

Figure 1. Executive Leadership

Spirit’s main goals are stated in its vision, strategy, and value statement. (See Figure 2)
The first goal is to be a preferred partner in the aircraft industry by being known as a high quality organization, and one that other aerospace companies want to do business with. The second goal of the organization is to grow the business with a balanced portfolio. This involves investing in a variety of different types of work, so that if one particular area of operations is down, another one is up to offset it. By keeping a diverse area of expertise, Spirit can maintain its value and shareholder confidence through the ups and downs of the economy. Last, Spirit wants to create long-term value. The organization believes that by accomplishing the first two goals, it can
continue to grow its business and create a solid foundation for growth well into the future.

Spirit Aerosystems’ operating values have always reflected its goals. It wants to be customer focused, maintaining a commitment to provide its customers with a high quality, cost competitive product. A market-driven culture would make sure that Spirit keeps a good financial base for investing in business growth. A high level of performance excellence would assure that it competes successfully in the aerospace industry. The company will treat its employees and customers alike with dignity and respect, to ensure the loyalty of the workforce and the companies it does business with. Last, Spirit will use teamwork as a platform for success, utilizing the talents of its people to their fullest extent.

The purpose of this project was to provide data that would improve the success of the training department at Spirit Aerosystems. The training team consists of six Human Resources Specialists in charge of training and certifying over 800 people. Most of these certifications must be renewed on an annual basis. That means the testing and training is a continual process, which must be constantly updated and refined to match the constantly changing engineering involved in building airplanes.

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Being a manufacturer of aircraft components, Spirit has been under the constant scrutiny of the Federal Aviation Administration (FAA). The procedures and methods for qualifying and certifying employees to do their jobs must meet strict criteria, and undergo frequent audits. The training team can improve its success and efficiency by taking advantage of any opportunity it can find to do a better job. With such a large workforce to train, even small improvements increase efficiency when used consistently.

When this project was conducted, there were two training rooms at Spirit, with a third being built. Each training room has two Human Resources Specialists that administer the certification courses. Most of the courses consist of classroom lecture, practice review exercises, a written exam, and a practical skills demonstration. All of these parts of the training are given in the classroom, except the practical skills demonstration. The classrooms are totally enclosed, sound-proofed, and inside bigger buildings. The acoustic qualities of the classrooms provide an excellent environment for background music. The training room being used for this study is located in Spirit Aerosystems Building 001. There are approximately 200 employees in this building who get their training and certifications done in this classroom.
History and background. One problem that has existed in the training program at Spirit Aerosystems, is that because of the large volume of students that are handled, time to look for improvements has been extremely limited. Many ways of creating value-added changes may have been overlooked. By focusing only on background music, the study was able to pinpoint some definite conclusions without impacting the training schedules.

This study was undertaken to serve as not only an indicator for the positive effects of background music in the learning environment, but also as a starting point for further changes in the training program at Spirit Aerosystems. As indicated by the research, there are many factors which influence a learner's ability to absorb information. All of these factors should be looked at and studied in order to update and maintain a viable and effective training department.

Scope of the problem. The scope of the study was limited to one type of background music. Other environmental factors such as lighting levels, spatial limitations, room temperature, and seating type, were not addressed for a number of reasons. One reason was the inability of the trainers to vary these factors. Another is time constraints on preparing the room. By limiting the study to background music only, a more accurate and cost effective conclusion was attained.
This study was contained to only one training room in the facility. This resulted in more consistent and reliable data, due to the ability of the trainers to maintain better control of the variables. The training room used, was the newest and best insulated of the classrooms, and was in an isolated location on the third floor of the central mezzanine. This provided a good distance from the noise on the shop floor.

The employee population involved in this project consisted of approximately 200 people. They included Composite Technicians, Structural Mechanics, Traffic Control Operators, and Quality Assurance Technicians. The certification course studied was Electrical Bonding Type I. This course was chosen for the study because it is the one most often given in the training department, and would provide the largest amount of data.

Significance of the Project

This project provided significant benefits for Spirit. The workforce will be better trained and better able to perform their jobs because each employee’s maximum potential has a better chance of being utilized, if they are properly trained. The time it takes to complete the certification courses will decrease, meaning a quicker turn-around time for employees getting back to the manufacturing floor, resulting in less overhead costs associated with training time. These benefits...

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will contribute directly to the company’s goals of performance excellence, high quality, and long-term value.

This study was unique in its method of finding a way to save the company time and money. While there has been much research done involving music in the classrooms of school age children, very little has been done in adult training environments, thus, this study provided an excellent opportunity for new findings. The project was also unique by the fact that while most improvements require initial investments in time and resources before realizing a gain, this project offered many advantages without any costs of implementation. By utilizing elements already in place, there was no need for extra equipment, or schedule interruptions. No major changes in the facilities were necessary to conduct this study, nor were additional personnel needed. The resources of the company were not taxed or disrupted. It was conducted completely during the normal course of operations.

This study has the potential for further applications. It could result in other factors in the training classroom being studied such as lighting, seating, temperature, and space limits. Conducting this same type of study in office environments, could result in similar benefits as in the classroom. Hence, the potential for building on this research and applying it throughout the facility is very great.
Definition of Terms

Certification: A training course for a specific skill that must be administered, and then repeated yearly. Certifications usually consist of lecture, review exercises, and an exam which must be passed.

Qualification: A training course that only needs to be given once.

Composite Technician: A person trained in the field of building aircraft components out of mostly non-metallic materials, such as fiberglass, carbon-fiber, and resin-epoxy systems.

Structural Mechanic: A person trained in the field of assembling simple and complex aircraft components, using a variety of fasteners including rivets, bolts, and adhesives.

Quality Assurance Technician: A person who possesses a wide span of knowledge about many of the processes of aircraft manufacturing, and is responsible for inspecting and approving the parts, assemblies, and processes, involved in the facility.

Traffic Control Operator: A person who is trained in and operates various types of transportation equipment, such as forklifts, side-loaders, and semi-trucks.

Electrical Bonding: Establishing an acceptable electrical connection between two parts or fasteners. It must meet specification requirements.
Specification: A controlling document that lays out all of the specific requirements for a particular process. Almost every different process of aircraft manufacturing has its own specification.

Powered Hand Truck: A small electrically operated truck used for moving small loads of materials or parts.

Tempo: The speed of the beat pattern of music.

Timbre: Also sometimes referred to as the tone color of music, this term means the special tone quality or sound of an instrument.

Review of the Literature

In the fast paced and competitive business world of today, it is more important than ever for companies to increase productivity through cost effective steps. The organizations that can do this will stay a step ahead of their competitors. There are many directions in which companies can look to achieve these value added changes. One is in the area of employee training with a focus on the optimal physical environment for learning. By specifically focusing on background music in the training room, it can be determined if this music can be used to produce better learning results, as measured by the test scores and survey results of the employees.

Benefits of Music
The benefits of music are widely varied and have been well studied and documented. One article in *Journal of Advanced Nursing* (2006) reports on a study testing the effects of music on power, pain, depression, and disability. A sample of 60 adults, ages 21 to 65, with chronic non-malignant pain was studied. They were divided into three groups; two with music, one without music. The music groups reported more power and less pain, depression, and disability, than the non-music group. The researchers concluded that nurses could teach the patients how to use music to help with pain management (Good, 2006).

There has even been some research pointing to actual biological effects of music. Susan Hallam, Ph.D. of the Department of Psychology and Special Education at the Institute of London, reviewed over 200 music-related scientific studies, reports, and books (Ambroziak, 2003). Hallam noted that while not every study has shown the predicted effect, evidence suggests music does have an effect on brain function. (Ambroziak, 2003, p. 30). Hence, on a biological level, the body’s vital signs tend to increase in response to loud, fast-paced music, and decrease in response to soft, slow music (Ambroziak, 2003).

**History of Music in the Workplace**

Historically, the effects of music in the workforce have been well studied. Le and Gordon (2005) found that music has...
long been a unifying force among workers. They also found that it can improve team spirit, and provide an enjoyable diversion (Gordon & Le, 2005). In the modern day work environment, one has only to walk through a manufacturing facility to see how prevalent the use of personal music devices is. In their article in the *American Journal of Public Health* (2005), Le and Gordon studied the history of music in the workplace, and found that it was likely to have been present in even the earliest societies.

Music is such a common pastime, it is not hard to understand how it could be used to motivate and inspire workers in almost any occupation. Whether simply relieving the monotony of a repetitive job, or helping workers to relax and be more productive, music can be very beneficial to companies and employees. In the article, “We Sang Ourselves Through that War”, the authors researched the role of music with women factory workers in the Second World War. Overall, they came to the conclusion that music in the armaments factories served as a unifying and harmonizing force which contributed greatly to the team cohesiveness of these women, many of whom had never been inside of a factory before (Jones, Korczynski, Pickering, Robertson, 2005).

The job improving role of music has carried over to the present day work situation as well. The article “Workers Tuned In”, in *Journal of Accountancy* (2007) supports this position.
survey in this article revealed that 89% to 90% of workers, age 18 to 39, believed that listening to music improved their job satisfaction and productivity. A clear indicator of the importance a majority of the workforce places on music. The same survey found that of older adult workers who listened to music while working, 55% felt it improved their job satisfaction and performance (Workers, 2007).

Other Environmental Factors

Much research has been done about the effects of physical environmental factors on learning. Among the environmental factors studied, background music is only one of many. Other factors studied include: lighting, heating, ventilation, and acoustics. One article, published in Research and Education, (2006) looked at the possibility that “green” schools improve learning performance. According to “Environmental and Educational Performance, with Particular Reference to “Green” Schools in Essex and Hampshire”, a “green” building of any kind is one that is built with environmental concerns in mind, and has a sustainable environment (Edwards, 2006). The study, in general, looks at the effects of the physical environments of these schools, on learning. From the scope of this study, it is clear that the physical learning environment as a whole, was considered paramount in the construction of these schools.
Another article, “Physical and Psychological Aspects of the Learning Environment in Information Technology Rich Classrooms”, reports on the effects of the physical and psychosocial environments of Internet classrooms (Straker & Zandvliet, 2001). This study examined not only lighting, but air temperature as well. The data concluded that inadequacies in the factors of air quality, lighting, and spatial limitations, could be seen as distracting the learner from learning (Straker & Zandvliet, p.843).

They interpreted their data to say that providing students with a good working environment was not just a matter of comfort, but rather a matter of learning efficiency (Straker & Zandvliet, 2001).

A third aspect of the classroom environment that affects learning is temperature. Anyone who has ever had to sit in a hot classroom and try to study, knows that uncomfortable room temperatures do not contribute positively to concentration levels. Most people will agree on this with a fair amount of unanimity. The comfort of a student indirectly makes a difference in their learning, by affecting their concentration. The question is; what level of comfort is optimal for learning? An article in Air Conditioning Heating & Refrigeration News (2000) looks at the opinions of educators on this subject. In all of the surveys, heating and air conditioning and lighting...
were listed as two of the three most important needs, surprisingly ranking far higher than technology (Siegel, 2000).

In looking at the studies mentioned above, the importance of the physical environment in learning is conclusive. Further research in this study shows that positive results can be gained in the workplace training room when these environmental factors are considered. Companies could benefit from better trained employees, and one way to do that, is by finding the best possible physical environment for learning. Companies may be missing out on an opportunity to produce more productive employees, at little or no cost increase, by failing to address these concerns.

Effects of Background Music

This project will focus on how the environmental factor of background music affects learning in the training room. Out of all the factors mentioned above, there has been the least amount of research done on background music, but by studying its affects in many areas of human physiology and interactions, researchers have concluded that it has played a definite role in a variety of learning environments.

The Mozart Effect

One popular theory concerning the effects of music on learning is called the Mozart effect. This theory was first tested in a study of 36 college students, whose ability to
mentally rotate three-dimensional objects temporarily improved after listening to 10 minutes of a Mozart sonata. The findings were well publicized, and quickly took on the label of the Mozart effect (Estel, Jones, & West, 2006).

There are differences of opinion on the reasons for the Mozart effect. The original researchers believed that the music of Mozart acted as a warm up for the brain, thus creating a more receptive mind for a greater learning capacity. Other researchers concluded that Mozart’s music heightened the mood of the listeners, creating optimum mental arousal for test taking (Estel et al., 2006). One study in Educational Studies (2002) supports this hypothesis. It suggests that the effects of music on task performance has more to do with arousal and mood than actual cognition. Hallam (2002) came to this conclusion after her study revealed that while background music enhanced the speed of working on mathematics problems, it did not increase the accuracy (Hallam, 2002). Regardless of the reasons for the Mozart effect, it peaked the interest of students and instructors alike, opening the door for further investigations into the effects of music on learning.

Types of Music

Studies have differed greatly in their approaches to researching the effects of background music on learning. While some researchers hypothesize that the type of music played is...
the most important variable, others investigate such variables as the volume of the music, the beat of the music, or whether the music was played before testing, during testing, or both. The type of music, the time it was played, the tasks to be performed, and the setting of the study, were all investigated in an experiment in 1993, and reported in *Language Learning* (2006). Felix concluded that classical music had a positive effect on performance when it was played during learning, but she did not stop with that one finding. She also found that the best retention level was attained when the music was played during learning, and during testing. This combination of factors was very significant, and supported the phenomenon of context-dependent memory; test performance is better, the closer the settings of learning and testing resemble each other (Annette & de Groot, 2006).

Although Felix’s findings supported the idea of the positive effects of style controlled background music on learning, some studies indicate little or no difference in learning, between environments of classical background music, and any other style of music. One article in *Journal of College & University Student Housing* (2005) promotes the use of a smooth jazz format background music for new college students. The authors of the article created a compact disc (CD) entitled *Jazz for Success*. Barber and Barber (2005) claim that the background
music in *Jazz for Success* calms and relaxes first year college students when played with presentations or lectures on college life, hence helping them remember important strategies for success (Barber & Barber, 2005). These inconsistencies between studies have led researchers to look for other variables which may be at play.

**Tempo and Timbre**

Since research has revealed that over 90% of television ads employ the use of music to create a specific mood, the effectiveness of music as a stimulator is clear. An article in *Applied Cognitive Psychology* (2006) investigated the effects of the tempo and timbre of background music, and how they influenced responses to radio ads. The results were mixed. One study revealed that changing from one tempo to another, either fast to slow or slow to fast, during word learning, decreased recall of the words. Another study showed classical music of varying tempi, to have no effect on ad content recall. The results became even more inconclusive, when a third study on music tempo in the same article, suggests a positive effect on recall related to a slower tempo. An explanation by the author clarified the findings. The author concluded that faster tempo music requires more processing capacity, and thus distracts from ad processing in the brain (Oakes, 2006). Similar studies, reported on in this article, were performed by varying the...
timbre of the music. Much like the studies on tempo, the results were mixed.

Learner Personality Traits

The personality traits of the learners is another variable that has been studied in an attempt to narrow down the exact nature of music and learning. A study detailed in Ergonomics (2002) investigated the distraction of background music and noise on the test performance of introverts verses extroverts. The authors were trying to find out if music could be as distracting as plain noise. They were challenging previous research which suggested that outside distractions, such as music or television, more negatively affect the test performance of introverts than extroverts.

In their study, thirty-eight introverts, and thirty-eight extroverts, were given tasks in reading comprehension, prose recall, and mathematics. They performed these tasks in three different physical environments: silence, background music, and office noise. The researchers had predicted that the performance of both personality types would be lower in the background music and noise environments, than in the silent environment, but that the extroverts would be negatively affected less than the introverts (Furnham & Strbac, 2002). The following figures indicate that their predictions were correct:
Figure 3. Comprehension (Furnham & Strbac, 2002)

Figure 4. Recall (Furnham & Strbac, 2002)
All three tasks showed the best performance in a silent environment, with the introverts performance dropping significantly more than the extroverts performance in the music and noise environments. Therefore, according to this study, personality type plays a role in the effects of background music on learning.

Music Preferences

The musical preference of the learners was another factor studied in an article in Educational Psychology (2006). In the article “The Cognitive and Academic Benefits of Music to Children: Facts and Fiction”, several studies were researched. Although these studies were conducted primarily on children, the overall conclusion was that positive moods facilitate optimum task performance, while negative moods disrupt performance. This points directly to the practicality of playing music that is...
enjoyable to the learner, to achieve the maximum benefits in task performance (Črnčec, Prior, & Wilson, 2006).

Conclusion

Much time and effort has been devoted to defining the role that music plays in learning. In looking at the previous research, a common element is clear even though the results of the studies vary greatly. This collective interpretation is stated plainly in a study in *Montessori Life: A publication of the American Montessori Society* (2005). It simply says that music enhances learning by focusing and ordering the mind (Jones, 2005, p.42). Jones goes on to explain that music basically trains the brain to order itself.(p. 43). By taking into consideration the data from this article, and other previous research, this project will attempt to apply some of the same principles of the effects of background music on learning, to an adult training room situation.

Methods

Hypothesis

This study was conducted to determine the effects of background music on the test scores of Spirit Aerosystems employees in Tulsa, Oklahoma. The expected outcome of this study was that the playing of low-volume classical music by composer Wolfgang Amadeus Mozart, during normal certification testing,
would result in significantly increased test scores of the adult
training students at Spirit Aerosystems.

**Data Source**

This study was conducted using a quasi-experimental research design to obtain its results. The test selected for use in the study, was Electrical Bonding Type I. This test was chosen for a number of reasons. One is because it is given more frequently than any other certification test at Spirit Aerosystems, hence providing an opportunity for the most amount of data. Another reason is because it must be taken individually by the student, not in pairs as with many of the other certification tests. Last, this test was chosen because it does not require the use of the computer, and includes a wide range of subjects. A few examples of the test material include: Ohms conversions, which use mathematical exercises; specification questions, which require use of memory recall; and practical application questions, which cover operational procedures for Ohm meter usage and reading. The students for both the non-music testing, and the music testing, were selected by using normal daily training classes; as employees were due for re-certification, their names were pulled up on a tab and they were notified to attend class on a certain date and time. The first 15 employees after the study began on December 1, 2007, were given the exam without background music. The next 15 were given
the exam with the background music. The study was concluded when the second 15 employees had completed the exam. The participants ranged in age from 20 to 60 years old. Experience in the field ranged from six months, to thirty years. These two factors assured that the study covered a wide spectrum of knowledge levels.

Instrumentation

The independent variable for this study was background music. Various compositions of Mozart were played at a very low volume, while the exam was being given. It was broadcasted over four speakers mounted in the ceiling of the training room, which produced a very evenly distributed sound. The trainer was in charge of administering the independent variable, and controlling the volume and content of the music. The students were not informed as to the reason for the background music.

The dependent variable of this study was the test scores, which were measured on a standard zero to one hundred scale, with zero being the lowest score, and one hundred being the highest. A score of seventy or better is required to pass the test, which consists of twenty-seven questions, with each question worth 3.7 points. This test has been used by the training department for many years, and through practical observation has proved to be a valid tool for determining the learning levels of the employees.
Procedure

In this study, students were given a standard exam. The following compositions by Mozart were played at very low volume levels: “Fantasy in d minor”; “Quartet for Oboe, Violin, Viola, and Violoncello in F Major”; “String Quartet No.17 in D Flat Major”; “Trio for Piano, Violin, and Violoncello in E Major”; “Quintet for Clarinet, two Violins, Viola, and Violoncello in A Major”; “Piano Sonata in B Flat Major”; “Piano Sonata No. 11 in A Major”; “Piano Sonata No. 15 in C Major”; “Sonata Facile”.

The participants started the test at the same time, and were instructed to remain seated when finished, until everyone in the class had finished. This was done in an effort to eliminate distractions during testing. All environmental factors of the classroom were closely monitored, to ensure nothing was different in any of the classes, except the presence of background music or not. Class sizes ranged from three to five. The tests were collected and graded following each class, with the scores recorded in an excel spread sheet. The trainer was present, and monitored the testing and grading, thus insuring an acceptable level of accuracy, and a presumption of reliability. This process took about 85 days to complete.

Data Analysis

Descriptive analysis. The means and standard deviations for both groups were found by analyzing their test scores.
graphs illustrating the data were produced using WebSTATISTICA (Statsoft, 2007).

Inferential analysis. The alternate hypothesis was that there would be a significant increase in the test scores of the group who were subject to background music, over the test scores of the group that had no background music ($H_a : \mu_m > \mu_{nm}$). The null hypothesis stated that the scores of the group with the background music, would be less than or equal to the scores of the group with no background music ($H_0 : \mu_m \leq \mu_{nm}$).

Limitations

There were several limitations to this study that could have prevented it from being entirely conclusive. Some of the participants may have experienced physical or mental symptoms, which affected their test performance. Stress levels of their job routines vary from department to department, thus creating an uneven mindset in groups taking the test together. Due to time constraints, only one type, tempo, and volume, of music was employed. Some previous studies indicated that different types of music produce different results. Last, the different age and experience levels of the participants could have played a significant role in the test scores, regardless of the presence of background music or not.

Summary of Results
There were a total of 30 students tested for this quasi-experiment. The sample size for each test group was 15. A histogram showing the total of all scores can be seen in figure 6, reflecting a mean score of 90.54 with a standard deviation of 5.9.

![Histogram of all scores](image)

**Figure 6: Histogram of all scores**

A comparison can be made between the dependent variables of the two test groups by looking at figures 7 and 8. Figure 7 is a histogram of the group without the music. It reflects a mean test score of 89.53 with a standard deviation of 5.37.

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Figure 7: Histogram of scores without music

The group testing with the music had a mean test score of 91.5 with a standard deviation of 6.38, and is shown in figure 8.
Figure 8: Histogram of scores with music

A quick look at both histograms reveals only a minimal difference between the two groups.

Inferential Data Analysis

The experiment had a level of significance of .05, and was performed by employing a two-sample t test. It had a critical value of 1.701, with 28 degrees of freedom. Since the calculated t value of .925 was less than the critical value, the null hypothesis could not be rejected. There was no significant difference in the test scores of the two groups. The mean plot in figure 9 illustrates that even though there was an increase in the mean of the test scores with the music, it was extremely slight and probably not statistically significant. It also shows the overlap of scores between confidence intervals of the two groups.
Additional Statistical Analyses

There were many additional variables collected when assembling the data for this experiment. These included age, gender, length of service, job title, and testing times. Of these variables, length of service and age could most likely have played a role in the outcome. An ANOVA was performed on these two variables, and the results are shown in figures nine and ten.
Figure 10 reveals that years of service had little to do with test scores.
Figure 11: Relation of scores to age

Figure 11 shows that age was no more of a factor than years of service, with no clear trend evident in either of these two variables. Although not shown here, further analysis of the remaining variables, also yielded no significant effect on test scores.

General Discussions and Conclusions

The purpose of this study was to see if playing background music during the testing of students in an adult training class, would have any effect on test scores. The alternate hypothesis stated that the background music would increase the test scores significantly. The results of the data analysis did not support
this hypothesis. Although it showed a trend in support of the hypothesis, it was not statistically significant. The positive trend in test scores of the background music students, presented a good possibility that with some modifications and further experimentation, a significant increase in test scores could be achieved. Other variables similar to those of the researchers in the literature review, could possibly have an effect on achieving higher test scores.

Strengths and Weaknesses of the Study

The study had two main strengths. First, the physical environment was very tightly controlled, thus providing a stable and consistent set of external stimuli that remained the same for each class. Second, the wide range of ages and years of experience assured a broad spectrum of knowledge with which to gather data.

The overriding weakness of the study was the time limit of the classes as well as the duration of the study as a whole. A longer time would have allowed for a more comprehensive collection of different types of music, tempos, and timbres, from which to gather data. As noted in the review of the literature, these other variables could possibly have had a significant effect on the outcome of the study. Another weakness was the lack of control in being able to randomly assign participants to groups.
Recommendations

Considering the minimal amount of significance found in the difference of the test scores, it seems likely that even with some modifications and changes in the variables, little benefit would be attained from further studies. It is highly unlikely that a high production/high technology environment, would realize any justifiable gains by pursuing it. Only a large and significant increase in test scores would generate the necessary incentive to proceed further in this course of action.

Suggestions for Future Research

As seen in the review of literature, environmental factors, such as lighting levels and temperature, might possibly play a role in students learning levels. Therefore, to achieve the greatest possible benefits from its training program, and stay competitive in its market, Spirit Aerosystems should pursue these other areas of the learning environment of its employees, and perhaps if these factors were controlled for another music study, one could possibly see a difference.

Matching learning style with environment might also be an area worth investigating in future studies. For example, some people need something playing in the background, while others require silence. Fine tuning these combinations of environmental factors may be the key in producing better learning results.
Background Music: Tim Jones

References


