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Participation In Instrumental Music As A Predictor Of Success In A Collegiate Level Aviation Flight Course

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PARTICIPATION IN INSTRUMENTAL MUSIC AS A PREDICTOR OF SUCCESS IN A COLLEGIATE LEVEL AVIATION FLIGHT COURSE

by

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This thesis, submitted by Tyson Jaquez in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

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4/19/2012

Date

TABLE OF CONTENTS

TABLE OF CONTENTS, CONT.

LIST OF TABLES

Table Page

LIST OF TABLES, CONT.

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ABSTRACT

Many varying studies have been conducted that examine the effect that learning a musical instrument has on the cognitive abilities of children and young adults. A number of these studies indicate that learning a musical instrument will enhance certain cognitive abilities. This study takes these theories and applies them to collegiate flight training in an FAA FAR Part 141 training environment.

Participants were surveyed about the extent of participation in instrumental music. These results were then matched with their flight and academic records for a collegiate private pilot course. Using different statistical comparisons, specific measures of success in the private pilot course were measured against different measures of participation in instrumental music. It was discovered that, for most of the areas explored in the study, there was not a significant difference between participants with instrumental music experience and those that were not involved in music. However, statistical significance was found to correlate general participation in instrumental music and a reduction in the number of flight hours necessary to complete the private pilot course. In support of these findings, when the instruments were broken down by group, participants that played the piano showed a significant reduction in the number of flight hours required to complete the private pilot course as well. These results demonstrate that there is some effect of participation in instrumental music on flight training, but more study is warranted.

CHAPTER I

INTRODUCTION

Music education and the benefits that students may gain from it has long been a topic of debate in the educational forums of the United States. These benefits have been researched, debated, extolled, and denied. Many advocacy groups, such as the National Association for Music Education (NAFME), provide statistics and anecdotes that support the benefits of an education that involves music (NAFME, 2012). This data, however, focuses mainly on student preparedness for college entrance exams such as the SAT. This study seeks to take this data a step further and discover if there are any benefits to be gained from the study of music in the area of aviation, specifically a collegiate level private pilot course. The question of the benefits of music education will be taken from the arena of college preparation and moved into real world practice within the area of flight training. This study seeks to demonstrate a link between the virtues of a musical education and success in a collegiate level flight course, and thus take music education from theoretical ideas to practical applications.

Review of Literature

The advantages of music education have been both extolled and denied. Indeed, this argument has even worked its way into the current education debate on whether keeping music and arts in the public schools is important or not. Petress (2005) cites that music is beneficial to students by creating success in society, school, developing

intelligence, as well as helping students to succeed in life. These are the ultimate goals of any educational system. By developing the areas of intelligence, social interaction, and social interaction in students, benefits will be gained as the students move into college and the workplace.

An important question that researchers are asking today is "does music make you smarter?" To this question, Schellenberg (2005) answers yes. While it is not a quick fix for educational problems, it has been demonstrated that listening to music can slightly enhance cognitive functioning over a short period of time, while participating in music lessons can lead to small, but longer lasting gains in cognitive functioning (Schellenberg, 2005). This belief that music can aid gains in cognitive function may help to validate music as a predictor of success in future employment.

To begin, a connection must be forged between music and aviation. Music, as will be evidenced in the following sections, has often been claimed to help promote cognitive growth and development within students that are involved in playing a musical instrument during their elementary and secondary school years. These cognitive gains may help these students as they look to a career in aviation. According to Kanfer and Ackerman (1989):

> Numerous studies have indicated that general abilities (e.g., reasoning) and broad content abilities (such as verbal, numerical, and spatial) predict individual differences in task performance. (p. 664)

Indeed, it will be evidenced in the following review of past literature, that it is possible that participation in instrumental music can affect verbal, numerical, and spatial abilities.

Therefore, aviation students who must use these abilities each day in their flying may be benefited by previous music training.

Music and Mathematics

Some of the most important aspects of music, including rhythm, pitch, and notation are involved with mathematical thinking (Caterall, Chapleau, & Iwanaga, 2009). This can be extended even more into individual instruments where complex linear geometries that are associated with the production of the pitch require spatial reasoning to correctly produce the desired pitch (Caterall, Chapleau, & Iwanaga, 2009). Participation in band or orchestra has also been shown to significantly increase the scores on math proficiency tests, especially for low socio-economic status (SES) students as compared to those low SES students not involved in band or orchestra (Caterall, Chapleau, & Iwanaga, 2009). This lends credence to the idea that participation in music can help students to perform better in their core classes, and set them up for future success as they move through their schooling.

Music and Language

Music relates to many different areas of brain function and cognition. Moreno (2009) discovered that people that underwent musical training had a better enhancement of musical representations in the auditory cortex of the brain when compared with people that had only undergone auditory training. This indicates that sensorimotor-auditory training, like that involved in learning an instrument, does indeed involve malleability, or brain plasticity, in this case within the auditory cortex (Moreno, 2009). Moreno also demonstrated that six months of musical training modified behavior and brain function.

This plasticity may lead to positive changes in the brain that will enhance cognitive abilities in later flight training.

Music and Other Fields

Participation in music also crosses many other fields, many of which are science related. In his article about the connection between music and science, Root-Bernstein (2001) points out that many of the driving scientists of today and in the past have had musical roots or been involved in music either through performance or composition. He postulates that there is a connection between music and science because they are fundamentally related. Adding to this, it has been discovered that there are structural brain asymmetries that are present in the brains of musicians and that have not been found in the brains of non-musicians. It is hypothesized this may be a result of the unusually high usage of the left hand in instrumental music which may restructure the interconnections of the brain, lending it to more scientific thought (Root-Bernstein, 2001).

In addition, Root-Bernstein (2001) has also found research projects stating that challenging hobbies may be predictors of career success. Indeed, participating in a challenging hobby, such as music, may predict long term success in the workforce. This is demonstrated by a project where forty scientists and their successes were statistically correlated with their participation in, among other hobbies, music and art (Root-Bernstein, 2001).

Early Childhood

Some scientists believe that music has effects on young children that may last into adulthood. Exposing young children to music, even before birth, has the possibility of helping to create neural pathways to the auditory cortex of the brain (Caufield, 1999). Creating extra links in the brains of children may indicate future cognitive benefits. In addition, since music is of interest to young children due to the fact that they can sing and dance and interact with the world around them (Črnčec, Wilson, & Prior, 2006), there is the added benefit of children being interested in an activity that will help shape and develop their cognitive ability. Črnčec et al. (2006) also found that participating in music lessons produced small to medium effects on the spatiotemporal ability of younger children. Although these effects are small, the may lead to future gains in cognitive development.

There is evidence that the age at which young children begin music instruction may have an impact on the amount of cognitive benefits seen later in life. Music instruction that begins before the age of five may have larger effects on non-musical outcomes than music instruction began later in life (Črnčec, Wilson, & Prior, 2006). Based on this evidence, younger children that participate in music have the possibility of the greatest cognitive advantages.

In order to find evidence that musical training actually has an effect on young children, some scientists have begun to look at the brain itself. Hyde et al., (2009) demonstrated that there is a link to brain development and music. They were able to show that fifteen months of musical training for young children around the age of six did

create an observable change in the brain. Students that participated in music for fifteen months had significantly different brain deformation changes from those of the control group. This same study also demonstrated that students that studied music for this same term showed a significant and near significant improvement in right and left hand fine motor skills, respectively (Hyde et al., 2009). Over their career, it is possible that musicians may demonstrate "sensorimotor and cognitive enhancements" due to continuous study of music and use of the sensorimotor network (Hyde et al., 2009). These findings point to the idea that musical training does have physical effect on the human brain, and may indeed indicate increased motor function that could help in learning to safely fly an aircraft.

Music can be said to play a very important role in the development of higher brain functions, partially because it can be universally appreciated by humans, even at birth. Some scientist have proposed that music may function as a 'pre-language' in the brain, and uses parts of the brain that are different from the generally accepted language centers. The firing patterns that this produces help the brain enhance its ability to further develop firing patterns that will lead to the improvement of other higher brain functions (Rauscher, Shaw, & Ky, 1995).

It has been suggested that training young children in music, because their cortices have a higher plasticity than those of older people, may cause a long-term increase in spatial-temporal reasoning abilities (Rauscher et al., 1997). In their study, Rauscher et al. (1997) tested this theory using seventy-eight preschool age children. It was discovered that students who were given keyboard lessons scored higher on spatial-temporal tasks

than those students that were only given instruction in singing, computers, or were not given any lessons at all over a period of six months. These results suggest that actual music training in contrast to listening may provide more long-term effects in the brain. This same study, however, failed to find a significant difference in spatial-recognition tasks (Rauscher et al., 1997).

Elementary School Music Education

Research has also been completed on children who participate in music during elementary school. Colwell and Davidson (1996) claim that it is important to realize that music is theoretically an intelligence all on its own, and should be nurtured in order for students to make the most out of their education. This attitude stems from a belief that music is of value to our society, and that there are gains to be made through participation in music.

Johnson and Memmott (2006), found that elementary school level children that participated in a music program that was rated by music education experts to be "exemplary" tended to score higher on both the English and mathematics portion of standardized tests. Although the effect size was small, this still provides evidence of possible enhancement of academic ability because of participation in music (Johnson & Memmott, 2009).

While some researchers have claimed that music has lasting effects on the cognitive ability of elementary students, other studies have yielded different results. Costa-Giomi (1999) demonstrated that although participation in piano lessons did initially improve the cognitive abilities of fourth graders after one and two years, these

results were not sustained. Once the study was completed after three years, results indicated that the non-participation group had caught up to the same cognitive level as those students taking piano lessons (Costa-Giomi, 1999). This could indicate that instrumental music does have an effect on cognitive development, but that this effect may not be sustained in the long term.

Studies have been conducted that link higher Intelligence Quotient (IQ) with participation in the arts, and specifically in music. Schellenberg (2004) completed one of the first studies that linked music and IQ directly. In this study, Schellenberg tested a group of six year olds for IQ to determine a baseline. This group was then divided into a group that took keyboard (piano) lessons, a group that took voice lessons, a group that took drama lessons, and a control group that took no lessons. At the end of one year, the participants were again measured for their IQ. After adjusting for IQ growth because of starting elementary school, Schellenberg discovered that those students that took keyboard and voice lessons had small increases in IQ over those students participating in drama lessons and those students who did not take lessons at all (Schellenberg, 2004). This study demonstrates, at least at a younger age, that taking music lessons can have a small, but noticeable effect on IQ.

These studies show that while there are effects that can be measured, these effects are relatively small. However, some of the effects that are derived may only give advantages for a short time before peers catch up developmentally. Small advantages, however, may add up over time.

Secondary School Music Education

The possible benefits of participating in instrumental music are not limited to elementary school. It may be argued that the greatest number of benefits may be gleaned during secondary school. Caterall, Chapleau, and Iwanaga (2009) showed that students highly involved in band or orchestra would outperform their peers that were not involved in these programs when it comes to math proficiency scores. This effect took some time to establish itself, however. The non-involved students scored slightly higher than the musically involved students in the eighth grade. However, by the twelfth grade, the musically involved students were scoring higher than the non-involved students by almost two to one (Caterall, Chapleau, & Iwanaga 2009).

Past research has shown that socioeconomic status (SES) has a large impact on standardized test scores. However, music has also been shown to have an effect. Fitzpatrick (2006) demonstrated that students that were ranked as low SES, and were active in either a band or an orchestra program, performed better on standardized tests over the course of several years than their peers who were not involved in music. This demonstrates that there is some effect of music on students, and that it may help them to succeed in school. This also indicates that music may help overcome the effect of low SES on school performance.

In connection with a study of elementary school students, Johnson and Memmott (2006) showed that participation in music at the middle school level does have an effect on academic ability. This study was able to demonstrate that students that were a part of an exceptional middle school music program performed higher on both the English and

mathematics portions of standardized tests and outperformed their peers that were not involved in music (Johnson & Memmott, 2006). It was also demonstrated in this study that students that were in poor instrumental music programs, as determined by music education experts, still scored higher than their non music peers on the standardized tests (Johnson & Memmott, 2006). This demonstrates that any participation in instrumental music has the potential to help the cognitive and academic abilities of middle school students, pushing them to succeed and to do better as they go through school.

In another study that focused on middle school students and their participation in band, Kinney (2008) found that band students, again, scored higher than their non participating peers. However, it was also noted in this study that SES had an effect on the test scores as well. Kinney (2008) states that it is possible that music attracts those students who are more likely to come from a higher SES and therefore perform better on standardized tests. It is difficult to tell which way the causation flows since previous research shows that both SES and participation in instrumental music have an influence on student performance.

Furthering the research in this area, a study conducted by Cheek and Smith (1999), looked into the relationship between eighth graders who received music lessons, those that only received music instruction in school, and others who took lessons on the keyboard. This study demonstrated that students who participated in private music lessons for at least two years scored significantly better on the mathematics portion of the Iowa Tests of Basic Skills (ITBS) than those students who did not participate in private lessons on their instruments (Cheek & Smith, 1999). It was also discovered that students

that took keyboard lessons scored significantly higher on the mathematics portion of the ITBS than students that took lessons on any other instrument (Cheek & Smith, 1999). This research opened up the possibility that private lessons in music have the potential of boosting mathematical ability, and thus set students up to be successful later in life.

Collegiate Music Education

While many studies have examined the cognitive effects of participating in instrumental music, some collegiate studies have focused on the students' own perceptions of how participation in these music groups affected them. In a study of two universities in the United Kingdom, it was found that collegiate level students, when asked about their participation in instrumental music, responded in three primary groups: musical knowledge, social effects, and personal effects (Kokotsaki & Hallam, 2007). Results from the personal effects category, show that these college students find that music has helped them to overcome challenges, build self confidence, helped with self-achievement, and helped to build leadership skills (Kokotsaki & Hallam, 2007). This demonstrates that, even without looking at the cognitive effects of music, participating in an instrumental music group can help to build many of the aspects that help to make people successful, regardless of their chosen career field.

In addition to students themselves perceiving added benefits of participating in music, there are also research studies that have concluded that music has effects on the cognitive abilities of collegiate students as well. Rauscher, Shaw, and Ky (1993) were among the first researchers to discover that listening to the music of Mozart may actually increase abstract reasoning skills for at least a small period of time. This study found that

listening to Mozart's piano sonata (K488) increased the abstract reasoning skills of collegiate students for a period of about ten minutes (Rauscher, Shaw, & Ky, 1993). This effect was thus dubbed the "Mozart Effect." Although the effects of this study were only temporary, it lead to even more research in the area of using music to enhance cognitive abilities in multiple age groups.

Another study, conducted by Rauscher, Shaw, & Ky (1995), that is a continuation of the original 1993 study, replicated the "Mozart Effect" in undergraduate students. This second study submitted participants to either silence, different music each day, or Mozart K448. It was found that participants in the Mozart group attained higher scores on a paper folding and cutting test, used to measure mental ability, than did those who were subjected to silence or mixed styles of music (Rauscher, Shaw, & Ky, 1995). This study helped to refute claims that the "Mozart Effect" was a one time occurrence.

A study, conducted on undergraduate students at a university in Toronto, directly related participation in music to later success in school. This study, conducted by Schellenberg (2006), demonstrated that participation in music in the elementary years is a significant predictor of success later in life. This included higher IQ scores, academic ability, and grade averages. The study also found that there was a positive correlation between length of time spent taking music lessons and increase in grade averages and perceptual organization and working memory (Schellenberg, 2006). These results were maintained even when the author held differences such as family income, parental education, and gender, indicating that these other variables did not have an effect on the results (Schellenberg, 2006). Based on the information from this study, it can begin to be

hypothesized that participation in music education may indeed lead to greater success in a collegiate level aviation course.

Arguments against music

In addition to the many studies that do indicate that participation in instrumental music can have a positive effect on the cognitive abilities of students, there are also some studies that indicate that music does not have these effects. Many of these focus on the "Mozart Effect" that was described by Rauscher, Shaw, & Ky (1993). Their research indicated that because of listening to a Mozart piano sonata (K488), college level students scored significantly higher on spatial reasoning test than those that listened to a relaxation tape and those that waited in silence (Rauscher, Shaw, & Ky, 1993). The "Mozart Effect" has not been able to be reliably replicated and thus may not be the "miracle cure" that many people made it out to be, according to Črnčec, Wilson, and Prior, (2006). Other reviews of the Rauscher study also cite that more research needs to be done into other genres of music as well as controlling for possible general arousal of the mind created by the music (Pietschnig, Voracek, & Formann, 2010).

Physical evidence of the effect of music on the brain

Adding to the wealth of information that music can have a noticeable cognitive effect on students, there are also studies that suggest that music may also physically change the brain, thus changing the way the brain operates. In a study that compared the sizes of the midsagittal area of the corpus callosum (CC), Schlaug, Jäncke, Huang, Staiger, and Steinmetz (1995b) found that there was a significant difference between musicians and non-musicians that were age-, sex and handedness-matched to control for

other possible influences (Schlaug et al., 1995b). The musicians in the study were found to have a larger midsagittal area in the corpus callosum than the non-musicians, leading to the theory that the number of fibers contained within the CC causes a difference in the amount of communication between the two hemispheres of the brain (Schlaug et al., 1995b). The difference, usually an increase in activity, has been hypothesized to be part of the complex two-handed motor skills that musicians use in performing on their instruments (Schlaug, et al., 2003). This may possibly lead to an asymmetry of sensorimotor areas and is evidence of brain plasticity in younger students (Schlaug et al., 1995b).

In a second study by Schlaug, Jäncke, Huang, and Steinmetz (1995a) it was found that musicians with the phenomenon known as perfect pitch, which allows the person to identify a pitch without a reference pitch, had a strong planum temporale asymmetry that favored the left side. While this same shift was not found in musicians without perfect pitch, it still lends credence to the idea that musical training, especially if it begins at a young age, may indeed slightly alter the brain and the way it functions (Schlaug et al., 1995a).

Another study, conducted by Schlaug (2003), discovered that there are differences in the volume of gray matter in the brains of musicians when compared to the brains of non-musicians. A higher volume of gray matter was found in the perirolandic region, premotor region, posterior parietal region, posterior mesial perisylvian region, and the cerebellum areas of the brains of musicians (Schlaug, 2003). This demonstrates a possible link between learning and playing music, and the physical effects on the brain.

Pilot Selection and Predictors of Success in the Aviation Industry

Throughout the history of aviation, the selection of pilots has always been an important area of study (Hunter & Burke, 2002). The majority of the studies that have looked into this area have focused on ab initio training in the military (Hunter & Burke, 2002). Many different measures have been used within the aviation field to help to identify potential pilots who will be more likely to succeed as pilots within the area of aviation that they are applying, commercial or military. These include, but are not limited to, verbal ability, quantitative ability, spatial ability, gross and fine dexterity, perceptual speed, reaction time, age, education and even personality (Hunter & Burke, 2002).

There are many different aspects that professionals use when they are trying to decide if a candidate will be successful within the aviation industry. In Estonia, Luuk, Luuk, and Aluoja (2009) demonstrated that extroversion, gregariousness and positive emotions could be used as negative predictors of performance in air traffic controllers. They also showed that gregariousness and positive emotions were helpful in predicting the ratings that were to be given by a direct supervisor (Luuk et al., 2009). In addition to the general application, this shows that other factors may also be predictors of success within the aviation industry. Beyond personality, other fields, such as music participation, may be able to add to this prediction of success.

In the United States, another study has also looked at the correlation between personality traits and performance of air traffic controller trainees. Oakes, Ferris, Martocchio, Buckley, and Broach (2001) examined the relationship between personality profiles that were taken during the application process to the Federal Aviation

Administration's (FAA) Air Traffic Control School in Oklahoma City. It was determined that controller applicants that have a higher cognitive ability will have higher levels of skill acquisition, controller applicants that are rated higher on B-reasoning will have higher levels of skill acquisition, and that controller applicants who demonstrated higher skill acquisition were a third more likely than their peers to gain a full performance level (FPL) once placed in an air traffic control setting (Oakes et al., 2001). This shows, within the aviation industry, that cognitive levels do have an effect on the level of performance. It is possible that the same holds true for pilots, and that any method of improving this cognitive ability may be beneficial later as one pursues a career in aviation.

A more recent study into selection of air traffic controllers delved into types of training as predictors of success later in an ATC career. Sethumadhavan and Durso (2009) looked into the selection of future air traffic controllers based on preliminary training in radar compared to non-radar scenarios. It was found that students that had non-radar training actually did better because of heightened situational awareness (SA) and keeping track of many things in the mind. This non-radar training assisted the ATC students who were able to more accurately predict what the radar would show later in the training, and thus perform better on the final tests (Sethumadhavan & Durso, 2009).

Training scenarios are also used to predict success in the piloting field of aviation. Cathay Pacific Airways, according to Bartram & Baxter (1996), has found that when predicting the success of both first and second officers, simulator exercises tend to be the most accurate indicator of later success. When looking for potential cadet pilots, Cathay

Pacific relies on a group flight planning exercise known as FPEX, to predict successful outcomes for their soon to be pilots (Bartram & Baxter, 1996). Although these are the two top indicators of pilot success within the company, Cathay Pacific also looks at items such as personality fit with the company, previous experience, problem solving, judgement, communications, leadership, and motivation to get an overall picture of the individual that is a potential pilot (Bartram & Baxter, 1996).

The Royal Air Force (RAF) takes a different approach to predicting the final outcome of pilot training. Three tests that are common in both the military and civilian pilot selection, and are used by the RAF include the Sensorimotor Apparatus (SMA), the Control of Velocity Test (CVT), and the Instrument Comprehension Test (INSB) (Burke, Hobson, & Linsky, 1997). These three tests, which have been validated, still require some improvement, but are still useful as pilot selectors. Research indicates that testing skill acquisition may help account for larger cognitive demands that happen at later stages in RAF training (Burke, Hobson, & Linsky, 1997).

The United States Air Force (USAF) also has a series of test that are used for predicting the success of students wishing to learn how to fly. The first of these is the Air Force Officer Qualifying Test (AFOQT) which is a multiple aptitude test used to sort applicants into officer training programs and to separate the airmen into either pilot or navigator programs (Carretta, 1992). The second test used by the USAF is the Basic Attributes Test (BAT) (Damos, 1996) which is comprised of measures for psychomotor coordination, information processing, personality, and attitudes towards risk (Carretta, 1992). Adding to these two tests, the USAF also uses an algorithm which combines the

trainee's scores and weights them according to established regulations to come up with an overall score. It has been found that the ranking weights for this algorithm do not have a large impact on the ranking of the future airmen once the given predictor variables are held constant (Carretta, 1992).

Another test that is used by the USAF is the Automated Aircrew Personality Profiler (AAPP). The AAPP is a test that contains scales from several different tests for personality, anxiety, behavior, and aggressiveness (Siem, 1992). This test, however, when tested for validity, does not appear to have a significant prediction when combined with the other measures that are used to predict pilot training performance (Siem, 1992). This does not indicate that personality is a bad predictor, indeed several studies have shown that personality is very important (Retzlaff & Gibertini, 1987). It appears that self-reported personality scores are not good predictors of pilot training success (Siem, 1992). This indicates that there is much room for improvement in the area of using personality to predict pilot training success.

Some scientists and researchers do not believe that the current state of selection of pilots is where it should be. Damos (1996) argues that there is much that needs to be done to help carefully and accurately predict the success of pilots. While many use personality as a predictor of success, Damos argues that what is most important is writing down exactly what the job of a pilot is and creating a battery of test to help predict success in those areas. It is also important to realize that the selection criteria for experienced pilots, which U.S. air carriers recruit from often, are different from the selection criteria for ab initio pilots, as is seen more in foreign air carriers (Damos, 1996).

The criteria for selecting pilots is slowly beginning to evolve. At first, pilot selection was mostly based on the applicants flying skills. However, crew resource management (CRM) skills are becoming more important as well (Hedge et al., 2000). A new measure for identifying CRM performance is the Situational Judgement Test (SJT). This test presents several job related scenarios, and asks the respondent to select between several alternatives, indicating which actions would be most and least effective (Hedge et al., 2000). This type of indicator has been pulled from other managerial fields, and is now being applied to pilots as a measure of CRM capability, adding to the already present tests for personality, sensory-motor tests, and others of a similar nature (Hedge et al., 2000).

Despite the current predictors of pilot training success, predicting the outcome for a new trainee is still a difficult process. Through examination of their past experiences, participation in instrumental music may provide another predictor of success. Music has been shown to enhance cognitive ability as well as fine motor skills, which would seem to indicate that it would parallel success in a flight training course.

Purpose Statement

The purpose of this study is to determine if there is a relationship between participation in instrumental music programs during elementary or secondary school and success in a collegiate aviation private pilot flight course. There are many interesting and compelling arguments that music can enhance cognitive ability (see Schellenberg, 2004), and indeed has been shown to raise scores on standardized tests (Cheek & Smith, 1999). This study will take this information and apply these theories to the arena of collegiate

aviation to explore the possible effects that the study of music may have on flight training.

Significance of the Study

This study will look at a different way of predicting success in a collegiate aviation private pilot course. Often, it can be difficult to predict the level of success that a student will have upon entering the college environment. Participation in instrumental music during the elementary and secondary education years may provide participants with benefits that will help them later on.

Research Questions

The review of the literature, which is located in the next section, helped to create five research questions. Using statistical analysis of the data collected, each of these questions will be answered. The research questions are:

1. Is there a relationship between participation in instrumental music during elementary/secondary school and success in a collegiate level private pilot course?
2. Is there a relationship between the amount of time spent studying instrumental music during elementary/secondary school and success in a collegiate level private pilot course?
3. Is there a relationship between the age at which the study of instrumental music began and success in a collegiate level private pilot course?
4. Is there a relationship between current participation in instrumental music and success in a collegiate level private pilot course?

5. Is there a relationship between studying and performing in a specific group of musical instruments and success in a collegiate level private pilot course?

Definitions

The following terms will be used throughout the study and are defined below for clarity.

1. Part 141 Flight School - a flight school that is certified under Part 141 of the Federal Aviation Regulations (FAR). These flight schools follow a prescribed and standardized curriculum for all students. This curriculum includes both a flight portion, which takes place in the aircraft, and a ground portion, which is taught in a general classroom (U.S. Department of Transportation, 2008).
2. Stage Check - the stage checks are the proficiency exams administered in the flight portion of the course. These stage checks are comprised of two portions each, an oral portion that measures a student's knowledge and a flight portion that measures the student's piloting ability. At UND, there are three stage checks for the private pilot course, the last of which is the final end of course test which leads to the issuance of a private pilot certificate.

CHAPTER II

METHODOLOGY

This study looks into the effects of participation in instrumental music, both past and present, ands it's effects on success in a collegiate aviation private pilot course. In addition, the project will explore the idea that studying instrumental music, or even specific groups of instruments, may have an effect on success in a collegiate level flight course.

Setting

This study was conducted at the University of North Dakota (UND) in Grand Forks, ND. The John D. Odegard School of Aerospace Sciences at UND contains a Part 141 flight school. Students earn a Bachelor of Science in Aeronautics, with a major in Commercial Aviation, among other aviation related degrees, through collegiate courses as well as FAA approved flight and ground classes.

Participants

The participants of this study were students that were currently enrolled in the Commercial Aviation advanced flight courses at the University of North Dakota. These students were involved in courses for which the private pilot course is a prerequisite as listed in Table 1. The study aimed to target the largest amount of students possible majoring in Commercial Aviation by spreading the sampling across multiple classes and

flight levels. To avoid confounding data, only students working on their degree in Commercial Aviation at the time of the study were surveyed.

Table 1.

Flight Courses Used in the Study

Course Number	Course Title
Avit 325	Multi-Engine Systems and Procedures
Avit 414	CFI* Certification
Avit 415	Instrument Flight Instructor
Avit 480	Advanced Aircraft Operations

**Certified Flight Instructor*

Instrument Reliability and Validity

Surveys about participation in music during elementary and secondary school and the impact of this participation on flight training have not been located through the literature review. The survey to be used in this study was reviewed by professionals in both the aviation and music fields to check for validity and reliability.

Data Collection

The researcher sought permission to enter the classrooms of the professors that teach the ground portion of the flight courses. With this permission, the study was presented to the students, who were then be asked to voluntarily participate.

There were two parts to the data collection process. The first part consisted of both getting voluntary participation, as well as determining the level of instrumental music participation. This was achieved through the use of a survey. The second part of the data collection required matching student ID numbers with their academic and flight performance in the private pilot course.

In order to collect preliminary data and to determine the extent to which each student was/is or is not involved in instrumental music, a survey was used (see appendix). The survey allowed the students the opportunity to include any instrumental music experience that is not on their academic records, and also allowed the students to give a time frame for later comparisons. The survey also gave the respondent a place to list the specific instruments and ensembles that the students were/are a member of and places to list the amount of time that the student spent in these organizations. The survey asked for the student identification number so that it can be matched with student records. This was accompanied with a statement about the intended use of the student identification number and that the number will be removed once the survey and flight records have been combined to ensure de-identification of the data.

After the data has been collected from the survey, the participant's student flight and academic records were pulled from the Aviation Information Management System (AIMS) used by UND. The participant's flight and academic records were matched with their survey using the student identification number. Once these pieces of data were matched, the data was de-identified, and each set given a separate numerical identifier for use in the data analysis process.

Data Analysis

Data analysis was completed using the SPSS software package. In order to answer the five research questions, multiple analyses were completed.

Success in a collegiate aviation flight course can be defined in many ways. Within this study, success in a collegiate aviation flight course will be examined using four different variables:

1. Number of flight hours required to complete the course.
2. The pass rate of successful completion of the stage checks for the course.
3. The academic grade received in the ground school portion of the course.
4. The number of attempts required to complete the private pilot course.

The research questions used for this project are listed below:

1. Is there a relationship between participation in instrumental music, during elementary/secondary school, and success in a collegiate level private pilot course?
2. Is there a relationship between the amount of time spent studying instrumental music during elementary/secondary school and success in a collegiate level private pilot course?
3. Is there a relationship between the age at which the study of instrumental music began and success in a collegiate level private pilot course?
4. Is there a relationship between current participation in instrumental music and success in a collegiate level private pilot course?
5. Is there a relationship between studying and performing in a specific group of musical instruments and success in a collegiate level private pilot course?

The statistical analyses that were used to answer these research questions are listed in Tables 2 through 6. These analyses were chosen based upon the nature of the variables that were contained within the measures used to answer each question. Pearson's *r* correlations were chosen where data for correlations that met parametric assumptions in research question 1. Spearman's rho was used for correlational data that did not meet parametric assumptions in research questions 2 through 5 (Field, 2009).

Table 2.

Statistical Tests Used to Answer Question 1

Independent Variable	Dependent Variable	Statistical Test
Involvement in Music	Number of Flight Hours	Independent t-test
Involvement in Music	Number of Stage Check Failures	Pearson's *r*
Involvement in Music	Ground Course Grade	Pearson's *r*
Involvement in Music	Re-take of Private Pilot Course	Chi Square

Table 3.

Statistical Tests Used to Answer Question 2

Independent Variable	Dependent Variable	Statistical Test
Years Studying Music	Number of Flight Hours	Spearman's Rho
Years Studying Music	Number of Stage Check Failures	Spearman's Rho
Years Studying Music	Ground Course Grade	Spearman's Rho
Years Studying Music	Re-take of Private Pilot Course	Spearman's Rho

Table 4.

Statistical Tests Used to Answer Question 3

Independent Variable	Dependent Variable	Statistical Test
Age Study of Music Began	Number of Flight Hours	Spearman's Rho
Age Study of Music Began	Number of Stage Check Failures	Spearman's Rho
Age Study of Music Began	Ground Course Grade	Spearman's Rho
Age Study of Music Began	Re-take of Private Pilot Course	Spearman's Rho

Table 5.

Statistical Tests Used to Answer Question 4

Independent Variable	Dependent Variable	Statistical Test
Current Participation in Music	Number of Flight Hours	Independent t-test
Current Participation in Music	Number of Stage Check Failures	Spearman's Rho
Current Participation in Music	Ground Course Grade	Spearman's Rho
Current Participation in Music	Re-take of Private Pilot Course	Independent t-test

Table 6.

Statistical Tests Used to Answer Question 5

Independent Variable	Dependent Variable	Statistical Test
Instrument Group	Number of Flight Hours	One Way Independent ANOVA
Instrument Group	Number of Stage Check Failures	Spearman's Rho
Instrument Group	Ground Course Grade	Spearman's Rho
Instrument Group	Re-take of Private Pilot Course	Spearman's Rho

Limits and Assumptions of the Study

This research study was conducted under several assumptions and limitations. First, the study focused on the relationship between participation in instrumental music and success in a collegiate level private pilot course on students from one university. The results of this study may not be generalizable to a wider group of people without further study. The results of this study will be further limited by the fact that the researcher only examined students that were majoring in Commercial Aviation and did not include any other majors, such as air traffic control (ATC), to avoid any confounding variables in the current study. Since the participants in this study are pursuing a four year degree in professional flight, these results may not be generalizable to general aviation (GA) pilots.

The researcher assumed that the instruction that was received by the students that participated in the study was equal. All flight instructors followed a prescribed syllabus

as described by the university's FAA approved Training Course Outline. The researcher also assumed that weather and other acts of nature that may have disrupted the flow of instruction affected each student the same, and therefore did not have a significant effect on the results of the study.

Protection of Human Subjects

Participation in this study was voluntary for all subjects. The plan for the study was sent to the Institutional Review Board (IRB) at the University of North Dakota. At this time, there are no foreseeable risks to the participants of this study. In order to keep all data confidential, student identification numbers were used only to match the surveys with the flight records. Once the data was paired it was given a unique identification and all other identifying data was removed, including the student identification number. At the end of the study, results are reported only as group data. All records and data used during the study will be stored in a safe place and will only be accessible to the researcher and research advisor. After a period of three years, all records and surveys used in this study will be shredded.

CHAPTER III

RESULTS

The purpose of this study is to determine if participation in instrumental music may lead to future successes in a collegiate level aviation flight course. Students at UND were surveyed, and their flight records were accessed. The results of these comparisons are presented in this chapter.

Description of the Subjects

The subjects surveyed in this study were all commercial aviation students that had taken Avit 102, the private pilot ground school, or the equivalent. Students were broken down by the actual private pilot course that they had taken. Most were in the general Avit 102 course. Others were in the Avit 105 or 112 courses for students that had gained previous flight experience. Some students‘ flight records did not list a private pilot flight course, most likely because they transferred in from one of UND’s satellite schools. The data used for analysis came only from those students that were involved in the Avit 102 private pilot course (N=78).

Measures

Several measures are used to determine success in a private pilot course. The first measure is the number of flight hours required to complete the private pilot course. There were some students that came into the private pilot course with flight experience prior to starting flight training at the University of North Dakota. Any student that had

over ten hours of experience before coming to UND was excluded from the flight hours analysis, leaving a slightly smaller sample for this measure, (N = 68). Table 7 displays the flight hours descriptive statistics.

Table 7.

Flight Hours Descriptive Statistics, N=68

Descriptive	Flight Hours
Range	45.7
Minimum	38.7
Maximum	84.4
Mean	58.3
Standard Deviation	10.5

The second measure used to determine success in a private pilot course is whether or not the participant passed their stage checks on the first attempt. Stage checks are comprised of two areas, an oral and a flight exam, and are administered by instructors other than the student's primary instructor. Changes in the curriculum lead to some students' stage checks being off from each other by one or two lessons, however, this should not compound the data since the stage checks all still test for the same skills. The Stage 28 stage check represents the FAA private pilot examination. The stage checks were labeled as follows for this study: Stage 13 Oral, Stage 13 Flight, Stage 24 Oral, Stage 24 Flight, Stage 28 Oral, and Stage 28 Flight. Table 8 displays the number of students, out of 78, that passed each stage check on the first attempt.

Table 8.

Stage Check Pass Rate

Stage Check	Number Passed on First Attempt	Percent of Students
Stage 13 Oral	75	96.2
Stage 13 Flight	58	74.4

Table 8. Cont.

Stage Check	Number Passed on First Attempt	Percent of Students
Stage 24 Oral	53	67.9
Stage 24 Flight	50	64.1
Stage 28 Oral	72	92.3
Stage 28 Flight	59	75.6

The third measure used to determine success in the private pilot course is the grade that the participant received in the ground portion of the private pilot course. The number of students having received each grade is shown in Table 9.

Table 9.

Grades Received in the Ground Course

Grade	N	Percent of Students
A	28	35.9
B	27	34.6
C	17	21.8
D	1	1.3
F	5	6.4
Total	78	100

The fourth measure used in this study to determine success in the private pilot course is the overall pass rate for the full Avit 102 course. This data is shown in Table 10.

Table 10.

Number of Re-Takes to Complete Private Pilot Course

Needed to Retake	N	Percent of Students
No	71	91.0
Yes	7	9.0
Total	78	100

Independent Variable Descriptive Statistics

It was discovered during this study that a high percentage of students that are seeking a degree in commercial aviation had also participated in instrumental music at some point during their elementary or secondary education. Table 11 displays these percentages.

Table 11.

Participants That Have Studied Instrumental Music

Participated in Instrumental Music?	N	Percent
Yes	67	85.9
No	11	14.1
Total	78	100

The average participant spent nearly five years studying instrumental music throughout their education. Some participants spent as many as sixteen years studying music before the survey was completed. Table 12 summarizes these results.

Table 12.

Years Spent Studying Music

Descriptive	Years Studied
Range	16.0
Minimum	0
Maximum	16
Mean	4.9
Standard Deviation	4.3

The average age at which the participants began the study of instrumental music was between eight and nine years old. This corresponds roughly to the third and fourth grades in elementary school. However, there was a wide range of ages at which the

participants began their study of instrumental music. Table 13 summarizes these statistics.

Table 13.

Age at Which Participants Began Studying Instrumental Music

Descriptive	Age
Range	21.0
Minimum	2.0
Maximum	23.0
Mean	8.7
Standard Deviation	2.9

The descriptive statistics demonstrated that a low number of students continued their musical pursuits concurrently with their involvement in a collegiate level flight course. Table 14 summarizes these statistics.

Table 14.

Participants Concurrently Involved in Instrumental Music

	N	Percent
Total Participants	78	100
Before Flight Training	67	85.9
During Flight Training	5	6.4

The participants in this study demonstrated a wide variety in the group and type of musical instruments that they studied. The instruments included woodwinds, brasswinds, percussion, strings, piano, and various other instruments. These are displayed in Table 15.

Table 15.

Instruments Studied by Participants

	N	Percent of Total
Band	65	83.3
Flute	1	1.3
Oboe	2	2.6
Clarinet	8	10.3
Bass Clarinet	1	1.3
Alto Sax	10	12.8
Tenor Sax	3	3.8
Bari Sax	1	1.3
Trumpet	15	19.2
Horn	5	6.4
Trombone	5	6.4
Baritone	3	3.8
Tuba	6	7.7
Percussion	5	6.4
Orchestra	4	5.1
Violin	2	2.6
Viola	1	1.3
Cello	1	1.3
Piano	32	41.0
Other	15	19.2
Guitar	11	14.1
Bass Guitar	1	1.3
Drum Set	1	1.3
Recorder	2	2.6

Statistical Results

The results of this study are broken down by research question and then by the measures used to answer that specific research question.

1. Is there a relationship between participation in instrumental music, during elementary/secondary school, and success in a collegiate level private pilot course?

The first area that was examined to answer this research question is the relationship between having studied instrumental music at some point and the number of flight hours that it took to complete the private pilot course. It was discovered using an independent t-test that on average, participants that had studied instrumental music at some point in their education tended to take less time to satisfactorily finish the private pilot flight course (M = 57.11, SE = 1.31) than students who had not studied instrumental music (M = 64.93, SE = 3.72). This difference was significant, $t(66) = 2.24$, $p < .05$. Although the results are significant, the effect size is small, r = .27.

The second area to be examined within this research question was the comparison between participation in instrumental music and success passing both the oral and flight portions of the three stage checks that happen throughout the course. Using Pearson's *r,* a negative correlation was discovered between participation in instrumental music and the number of stage checks, out of six, that were not passed on the first attempt, $r = -.17$, $p > .05$. Although this was not significant, it appears that participating in instrumental music may help lower the number of stage checks that are failed on the first attempt.

The third area within this question examined the relationship between participation in instrumental music and the grade that was received in the private pilot ground course. Using Pearson's r*,* a positive, but non-significant, correlation was found

between these two variables using, $r = .21$, $p > .05$. This indicates that students that participated in instrumental music tended to earn higher grades in the ground course.

The fourth area within this question was answered using an independent t-test to examine the relationship between participation in instrumental music and the rate that participants passed the private pilot course overall. It was discovered that there was not a significant relationship between passing private pilot course on the first attempt and participation in instrumental music x^2 (1) = 1.33, $p > .05$. The results for the first research question are summarized in Table 16.

Table 16.

Summary of Results for Question 1 - Involvement in Instrumental Music

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	Independent t-test	$t(66) = 2.24$	.021*
Stage Check Failures	Pearson's *r*	$r = -.17$	.152
Ground Course Grade	Pearson's *r*	$r = .21$	.069
Retake of Course	Chi Square	$x^2(1) = 1.33$	.249

** Results are significant at the .05 level*

2. Is there a relationship between the amount of time spent studying instrumental music during elementary/secondary school and success in a collegiate level private pilot course?

To answer the first part of this question, a Spearman's rho correlation was run between the number of years spent studying music and the number of hours necessary to complete the flight portion of the private pilot course. There was a non-significant negative correlation between these two factors $r_s = -.09$, $p > .05$.

The second portion of this question relates the number of years that instrumental music was studied to the stage check pass rate on the first attempt. A Spearman's rho

correlation revealed that there was a negative correlation between the number of years that instrumental music was studied and the number of stage checks that were failed on the first attempt. This result, however, was found to be non-significant, $r_s = -.11$, $p > .05$.

Next, correlations between the number of years spent studying music and the grade received in the ground course were examined. A Spearman's rho demonstrated that there was a non-significant, positive correlation between these two factors, $r_s = .10$, $p > .05$.

The last part of the second research question examined the relationship between the number of years spent studying instrumental music and the number of retakes needed to successfully complete the overall private pilot course. It was discovered, using a Spearman's rho, that there was a negative, but non-significant correlation between the number of years spent studying instrumental music and the number of times a student had to re-take the ground course, $r_s = -.10$, $p > .05$. A summary of the results for the second research question is displayed in Table 17.

Table 17.

Summary of Results for Question 2 - Number of Years Studying Music

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	Spearman's Rho	$r_s = -.09$	.448
Stage Check Failures	Spearman's Rho	$r_s = -.11$	.344
Ground Course Grade	Spearman's Rho	$r_s = .10$	.404
Retake of Course	Spearman's Rho	$r_s = -.10$	.378

3. Is there a relationship between the age at which the study of instrumental music began and success in a collegiate level private pilot course?

The first correlation used to answer this research question examined the correlation between the age at which the participant began studying music and the number of hours it took to satisfactorily complete the flight portion of the private pilot course. Spearman's rho revealed a negative, non-significant correlation between these two factors, r_s = -.11, p > .05.

The second test used to answer the third research question examined the correlation between the age at which the participant began their study of music and the number of stage checks that were failed on the first attempt. A negative, yet non-significant, correlation was discovered between these two variables using Spearman's rho, r_s = -.08, p > .05.

The third part of this research question examines the relationship between the age at which instrumental music study was begun and the grade that was received in the ground course. A Spearman's rho revealed that there was not a significant relationship between the age at which the study of music began and the grades that were earned in the ground portion of the course, r_s = .06, p > .05.

The last portion of this research question examined the relationship between the age at which the study of instrumental music began and the number of retakes required to successfully complete the overall private pilot course. A Spearman's rho revealed a non-significant, negative correlation was found, r_s = -.09, p > .05. The results for the third research question are summarized in Table 18.

Table 18.

Summary of Results for Question 3 - Age at Which Study of Music Began

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	Spearman's Rho	r_s = -.11	.456
Stage Check Failures	Spearman's Rho	r_s = -.08	.534
Ground Course Grade	Spearman's Rho	r_s = .06	.661
Retake of Course	Spearman's Rho	r_s = -.09	.516

4. Is there a relationship between current participation in instrumental music and success in a collegiate level private pilot course?

The first section of this research question was analyzed using an Independent t-test. On average, students that were currently studying instrumental music required fewer flight hours to complete the private pilot course (M = 57.02, SE = 4.62) than those that were not studying instrumental music (M = 57.79, SE = 1.25). This was not a significant result, t(76) = .16, $p > .05$ with a small effect, r = .02.

The second part of this research question examined if current participation in instrumental music had an effect on the rate that students passed their stage checks on the first attempt. A negative, non-significant, correlation was found between current participation and the number of stage checks that were not passed on the first attempt using a Spearman's rho, r_s = -.13, $p > .05$, indicating that, to a degree, currently studying music may reduce the number of fails on the first attempt.

The next part of this research question explored the relationship between current participation in instrumental music and the grade that was received in the ground course. A Spearman's rho demonstrated a positive, but non-significant, correlation was discovered between these two variables, r_s = .02, $p > .05$.

The last relationship in within this research question explored the relationship between current participation in instrumental music and the pass rate of the overall private pilot course. An independent t-test revealed that, on average, students that were currently studying instrumental music (M = .20, SE = .20) had to retake the private pilot course a second time while those that were not studying instrumental music did not have to retake the private pilot course (M = .08, SE = .03). This was not a significant difference, t(76) = -.89, $p > .05$ and represented a small effect size, r = .10. The results of research question four are summarized in Table 19.

Table 19.

Summary of Results for Question 4 - Concurrent Participation in Instrumental Music

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	Independent t-test	$t(76) = .16$	.877
Stage Check Failures	Spearman's Rho	$r_s = -.13$	.246
Ground Course Grade	Spearman's Rho	$r_s = .02$	.856
Retake of Course	Independent t-test	$t(76) = -.89$	.379

5. Is there a relationship between studying and performing in a specific group of musical instruments and success in a collegiate level private pilot course?

The last research question was answered using different sets of analyses. The instrument groups were broken down into the three different groups for analysis. These groups are Band, Piano, and Other Instruments. Due to the low number of retakes being spread across the different instrument groups, meaningful analyses for this measure could not be conducted for the fifth research question.

The first group to be analyzed was the group containing participants that were involved in band. A highly significant negative correlation was revealed by a Spearman's rho test that demonstrates that students that participated in band were less likely to retake the over all private pilot course, $r_s = -.30$, $p < .05$. A One Way Independent ANOVA revealed a non-significant relationship between participating in band and the number of flight hours required to complete the flight portion of the private pilot course, $F(1, 66) = 2.192$, $p > .05$, $w = .13$. Spearman's rho revealed non-significant correlations between participation in band and both the stage check failure rate and the ground course grade, $r_s = -.15$, $p > .05$, and $r_s = .22$, $p > .05$ respectively. Table 20 summarizes the results of participants that were involved in band.

Table 20.

Summary of Results for Question 5 - Band

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	One Way Independent ANOVA	F(1, 66) = 2.192	.143
Stage Check Failures	Spearman's Rho	*rs* = -.15	.191
Ground Course Grade	Spearman's Rho	*rs* = .22	.054

The next group to be analyzed was the group of participants that were involved in studying the piano. A One Way Independent ANOVA revealed a significant relationship between studying piano and the number of flight hours, $F(1, 66) = 4.158$, $p > .05$, $w = .21$. This indicates that participation on piano may decrease the number of hours it takes to complete the flight portion of the private pilot course. Spearman's rho revealed non-significant correlation between studying piano and the other three measures: stage check

failures, the grade earned in the ground course, and the need to retake the overall course. The results of the analyses of the piano group are reported in Table 21 below.

Table 21.

Summary of Results for Question 5 - Piano

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	One Way Independent ANOVA	F(1, 66) = 4.158	.045*
Stage Check Failures	Spearman's Rho	*rs* = -.81	.481
Ground Course Grade	Spearman's Rho	*rs* = .17	.133

** Results are significant at the .05 level*

The last group for which analyses were run is the group that contained participants that had studied various other instruments. A One Way Independent ANOVA revealed a non-significant relationship between participation in this group and the number of flight hours needed to complete the flight portion of the course, $F(1, 66) = .450$, $p > .05$, $w = .09$. Spearman's rho correlations demonstrated non-significant results for the other three measures: stage check failure rate, ground course grade, and the need to retake the overall private pilot course. The results of the analyses of the group that studied other instruments is displayed in Table 22.

Table 22.

Summary of Results for Question 5 - Other

Dependent Variable	Test Used	Test Statistic	Value of *p*
Flight Hours	One Way Independent ANOVA	F(1, 66) = .450	.505
Stage Check Failures	Spearman's Rho	*rs* = .15	.188
Ground Course Grade	Spearman's Rho	*rs* = .004	.971

CHAPTER IV

DISCUSSION

This study explores the relationship that participation in instrumental music has on the success of a student will have in a collegiate level private pilot course. This chapter presents a discussion of the results and analyses that were presented in the previous chapter and will conclude with areas for further research.

Discussion of Results

Significant Results

There were two sets of results that were revealed to be significant in this study. The first was the Independent t-test used to compare the number of flight hours to involvement in instrumental music. This demonstrates that there is a possible connection between the study of instrumental music and learning the skills necessary to pilot an aircraft. These results support the theory that music enhances fine motor skills (Hyde et al., 2009) and may indicate that this enhancement may transfer over into the motor skills required to pilot an aircraft. It is also possible that participation in general instrumental music may add to the brain plasticity (Moreno, 2009), allowing students to more readily absorb and understand the difficult concepts that are required by the flight portion of the private pilot course.

The second area in which significant results were demonstrated was the instrument groups. It was demonstrated with a One Way Independent ANOVA that

participation on the piano, specifically, lead to an decrease in the number of hours needed to complete the flight portion of the private pilot course. This upholds the findings of the first research question It may be possible that the piano provides more hand and eye coordination which may translate into an easier ability to learn to fly. It is also possible that the fine motor skills learned while at the keyboard help prepare the pilot for the fine tasks of flying an aircraft.

Non-Significant Results

While the significant results above provide tantalizing clues into possible links between music and flight, the lack of significant results can also reveal some interesting clues to this area of research.

When comparing the ground course grade to involvement in instrumental music, there was a positive correlation. While this result was not significant, it does indicate that there is a small trend happening among students that have participated in music. This lends credence to the ideas that music may increase cognitive and academic performance (Johnson & Memmott, 2006). It is possible that a larger sample may have demonstrated significant results in this area.

The other two areas of question 1 demonstrated very low relationships between participation in music and the failure rate of the stage checks and the need to retake the course. It appears that participation in music does not have a noticeable effect on these two areas of the private pilot course.

The second research question demonstrated interesting results, not with significance, but with a lack of significance. Spearman's rho correlations on all four

measures used to examine the effect that the amount of time spent studying music had on the private pilot course were all non-significant. These results are surprising because it was expected that the longer a person studied music, the greater the benefits would be. This was not the case. Indeed, these results tend to support the theory that music may not have the effects that some studies claim (Črnčec, Wilson, and Prior, 2006). This may also be due to the theory that the benefits of participation in music are short lived, according to Costa-Giomi (1999).

The third research question also revealed interesting results through lack of significance. As before, all measures in question 3 were revealed to have non-significant correlations with the age at which the study of music was begun. Past studies, such as the one conducted by Rauscher et al. (1997), indicated that the younger a student is when they begin the study of music, the more pronounced the effects will be because of brain plasticity. This does not appear to be true in the case of aviation. Students that began their study earlier did not appear to differ from those who began their study later in life. This may be important for students wishing to begin music at a later point in their education.

The fourth research question revealed, again, results that were not significant. First, considering the amount of students that, at some point in their lives, were involved in music, it was expected to see more students participating in music concurrently with their aviation program (See Table 15). In this area, it could be surmised that if past participation in music benefited the participant, then continuing that participation would also help. This was not the case. There were no noticeable differences between students

that were concurrently participating in instrumental music and those that were not. This ties into the question of how long the effects of music last. Again, Costa-Giomi (1999) and Rauscher, Shaw, and Ky (1993) demonstrated that the effects of music may only be temporary. Indeed, the results of this study show no significant difference between musicians and non-musicians.

It can be said that flight training takes a considerable amount of time due to necessary flight hours and the study involved, and the same can be said for the practice time that is involved in maintaining skills on a musical instrument. The very low number of students that continue on in music may be due to this conflict of time. This conflict, however, could be a perceived issue rather than a real issue. Whatever the reason, however, for this lack of continued participation in music, the results of all four measures in this area showed that there was not a significant difference between students that were concurrently participating in instrumental music and those that were not.

The fifth research question demonstrated that learning an instrument in a specific group (band, orchestra, etc.) does not have an effect on the private pilot course, with the exception of playing piano and the number of flight hours (see significant discussion above). This question was problematic in that there were not enough participants in the orchestra group to do the planned analysis. This highlights the fact that music programs vary so widely across the country, and may even vary from school district to school district. The low involvement of students in orchestra may stem from a lack of orchestra programs in the public schools, leading to a lack of orchestra students in any program. On the opposite end of the spectrum, there appears to be a large population of students

that were involved in band and piano. Further research in this area may include examining different flight programs to see if the same ratios exist for these specific instrument groups.

Overall, it can be concluded that participation in instrumental music does appear to have some positive effects on students in a collegiate level aviation flight course. The number of hours needed to finish the flight portion of the course tend to be less, the grades in the ground course tend to be higher, the number of first attempt stage check failures tends to be lower, and the number of attempts to complete the course tends to be lower. Although these results were not significant and thus cannot be demonstrated with confidence, this poses some interesting questions.

Practical Implications and Recommendations

There are several possible implications that could be derived from this study. First and foremost, this study underscores the necessity and importance of music education. Not only does music have the added benefits of enjoyment and continued learning, but it assists in other areas of life. This study has shown that participation in instrumental music may have many links to other seemingly non-related areas of study and may indeed help to increase the potential learning within another subject.

Another implication is flight training. The cost of flight training can be high. Because of this, predicting future success in flight training courses could be an asset to those that are involved with teaching and mentoring students wishing to pursue a career in aviation. With more study, it may be possible to loosely predict success based upon involvement in instrumental music. This would allow teachers and flight instructors

within the aviation field to target extra help and tutoring toward students that are more likely to need it, and allow them the succeed more easily.

In addition to possibly predicting success in a flight course, it is important to know that music has an impact, whether positive, negative, or none at all. This study demonstrated that music may have all three of these impact directions on flight training. Based upon this data, new studies can be created that look into causal aspects. It may be possible that some of the fine motor techniques taught in general instrumental music translate directly into the flight deck. It is also possible that some instruments, such as the piano in this study, enhance these fine motor skills. This study has helped to generate a baseline from which other comparisons can be made. It provides a broad topic area from which many different and more focused studies can form. Further research into these areas may provide new and innovative ways of teaching that may help further aviation education.

Another implication of this study is for parents. If their child is considering a career in aviation, it may be suggested that they have their child participate in some form of instrumental music. While this is not a guaranteed way to provide success in a flight training course, any and all programs meant to foster mental growth and help prepare students for challenges in the future is good exposure.

Future Research

Since this study appears to be one of the first of its kind, more research into this area as a whole is warranted. This study was limited to flight students of only one university. Broadening the study to include other flight programs around the country

would help to create a clearer picture of what effects participation in instrumental music has on flight training.

Future research may also include different groups of music. This study focused specifically on the traditional instrumental areas. However, there are many different areas of music, both instrumental and non-instrumental, available in the country. One of the biggest areas is vocal/choral music. There are also many different genres of music that could be explored including classical, pop, rock, alternative, and different regional music.

Part 61 and Part 141 Flight Training

One area of further research that may be of interest would be to compare the results found in a similar study of a Part 61 flight school. This study was conducted at a university flight school which is certified under Part 141 of the FARs. There are many schools in the country who operate under Part 61 of the FARs, meaning that they do not necessarily follow the same stringent requirements, mainly for ground school. A future project could look to see if the results that were discovered in this study held true or changed for a Part 61 school. It would also be possible to compare the two types of flight schools and determine if participation in instrumental music had a larger effect on one over the other.

Sample Size

Another consideration for future research would be to conduct a similar study with a larger sample size. Due to the limitations in the number of students in the program at any one time, and the differences in the preliminary flight training that were

encountered in this study, a large and robust sample size was not possible. A study that encompasses multiple flight schools may yield even more substantial results. A larger study would also allow for better comparisons between groups of instruments as well as include other types of music education, including vocal training.

Other Areas of Aviation

Further research could also be conducted in different areas of the field of aviation. Not only does aviation deal with flight training, but air traffic control (ATC) training as well. It would be possible to conduct a similar study that looked into the effects of instrumental and non-instrumental music education on students working toward a degree in ATC.

Conclusion

In closing, this study has lead to many interesting discoveries. First, based upon the significant results in this study, it can be said that the study of instrumental music can aid students in a collegiate aviation flight course, helping to extoll the benefits of music. It can also be said that the study of music on instruments like the piano, may actually benefit a student's learning in a collegiate level aviation flight course even more. This study has indeed brought the argument of the benefits of music around full circle. On one hand, benefits were found in some areas of the private pilot course. On the other, non-significant results demonstrated that there were not appreciable effects in other areas of the private pilot course. This duality led to more questions and areas for further research than the study sought to solve in the first place.

Overall, this study mirrors the results that have been found in previous research. There is clear evidence that participating in music did have a positive effect on flight time. Although definitive answers have not been found in some areas as predicted by previous research, this study has taken the benefits of music education out of the realm of college entrance exam statistics and applied these possible benefits to a real world application. The boundaries of music education have been pushed further out. If nothing else, it can be said that more research and study needs to be conducted in these areas, not only in support of music education but also in its relation to aviation education and flight training.

APPENDICES

APPENDIX A
Survey Form

Student ID#: _____

Your ID number will only be used to connect your survey with your student records. Once the data has been connected, all data will be de-identified; including the removal of all names and ID numbers.

****

1. Have you ever played a musical instrument?

    a. Yes

    b. No

2. If yes, did your receive formal training (lessons or classroom instruction) on that instrument?

    a. Yes

    b. No

3. What instrumental music programs or private lesson programs were you involved in during the following ages? (Check all that apply)

Age	Band (Winds/ Perc.)	Orchestra (Strings)	Other (Please Specify)	None
0-4				
5-10				
11-14				
15-18				
Over 18				

4. At what specific age did you begin studying music?

   _____

5. Please list the specific instrument(s) that you played, along with the number of years that you studied/played each one:

Instrument	Number of Years

6. Are you **currently** involved in an instrumental music program?
   a. Yes
   b. No
7. If yes, please list which instrumental program(s) are you currently involved in and which instrument(s) you play:

Music Program	Instrument

8. Did you have any previous flight experience before coming to UND?

   a. Yes

   b. No

9. How many flight hours did you log before enrolling at UND?

   _____

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