Programming to Music

Abstract:
Do college freshman perform better listening to music of their choice during graded computer programming labs? Previous studies of workplace productivity indicate an increase of about 5% after background music systems have been installed. Music seems to boost enthusiasm, increase relaxation and lessen nervousness and as a result, the elevated mood contributes to higher productivity[6]. Can music have this same effect in the classroom? A study was conducted on college freshman to determine the effects music had on learning Java programming. The hypothesis of the study was that students who listened to music of their choice would perform better on graded programming labs than those that did not listen to music. The findings of the study indicated that students did not perform well while listening to music. This is important as educators consider music in the classroom.

Introduction:
College students surround themselves with music. They listen to Ipods while walking and running. They blare music while driving their cars. They listen to music while studying in their dorms. They attend music concerts as a social activity. Music has become such an integral part of their lives. Music is so integral that students often request to listen to music during graded events. Could the inclusion of music in the classroom specifically during testing replicate their preferred environment and allow them to perform better?

In fact music in specific cases has had benefits. Presenting extraneous environmental stimuli by way of stereo headset is one way in which work performance has indicated further improvement. One hundred and fifty employees in clerical and administrative jobs were volunteers for a study in which music was played via headsets. The research indicated an average of 10% increase in productivity for those using headsets. However, the type of task moderates the benefits. The productivity in more “simple” jobs such as data entry increased by 14%. The more “complex” jobs such as account analysis increased by 6% [7]. Could these same benefits apply to computer programming?

Music has been used in the field of medicine with positive results. Therapeutic application of music in rehabilitation can ease the discomfort and difficulty associated with physical therapy exercise [8]. Music during physical exercise has resulted in increased endurance and performance [1]. Some studies have shown improved motor performance and increased aerobic endurance with the use of music during exercise [5]. Music has been shown to reduce blood pressure in performing potentially stressful tasks. A study measured the blood pressures of surgeons performing mental tasks. The blood pressures were reduced the most when they were able to listen to music of their choice while performing the specified task [4].

Computer science is no stranger to music. Music has been used to help teach computer programming. The inclusion of musical device control has been used to highlight important concepts and programming techniques in introductory computer courses [2]. Computer languages have been used also to model musical composition[9].Computer generated music can then be used to teach algorithms in computer programming classes [3].

Could the positive effects of music be transferred to computer science in particular the student learning environment? Is there a relationship between listening to music while programming and performance in the task (programming). The hypothesis of this study was that there is a positive correlation between listening to music while programming and programming performance as indicated by errors per line of code.

Method:

All freshman at the United States Military Academy are required to take IT105/IT55 regardless of their academic major. Students learn Java programming in the course. Three graded Java computer programming labs are conducted during IT105/IT155 of progressive complexity. Both courses contain the same course content and have the same graded events. IT155 is the honors version of IT105 and is comprised of students that demonstrate proficiency in their computer skills. A total of 477 students were enrolled in IT105 and 141 students were enrolled in IT155. All 618 students were given the same 3 Java programming labs for grade during the semester.

The first lab was 1 hour in length and half of the 618 total students were given the opportunity to listen to music. Only 128 chose to listen to music of their choice via headsets while taking the graded programming lab as shown in Figure 1. Those students who chose not to listen to music gave the reason that they thought it would be a distraction.

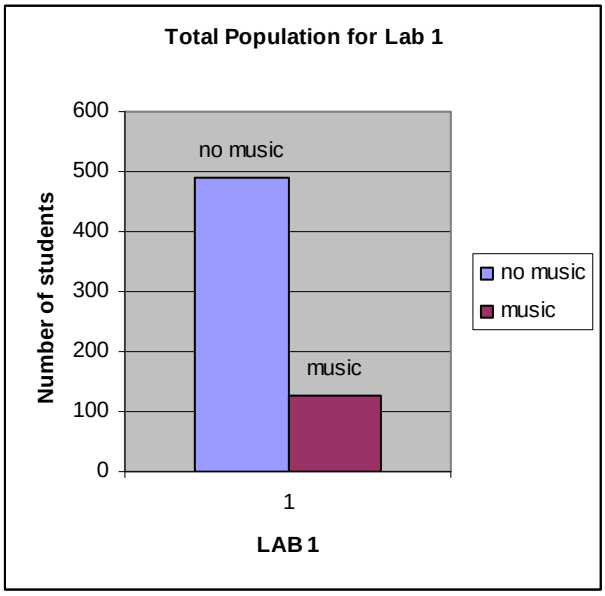
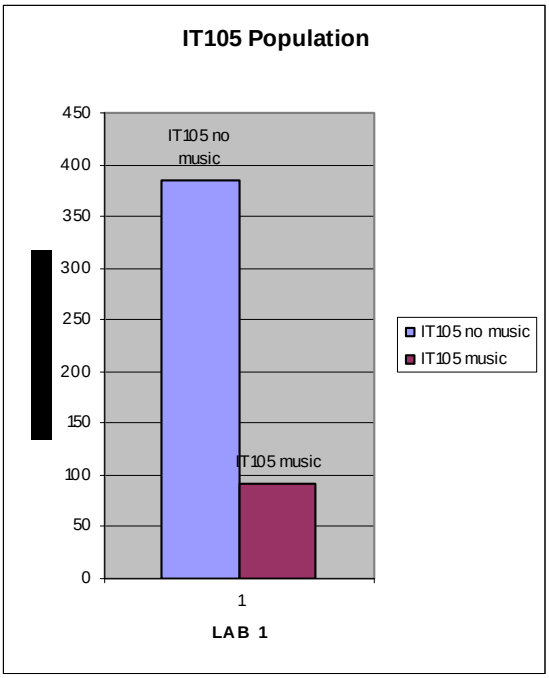


Figure 1

The total population can further be broken down by non honors course, IT105, and honors course IT155. There were 92 students from IT105 that listened to music and 385 students that did not listen to music as shown in Figure 2. The honors couse, IT155, had 36 students that listened to music and 105 students that did not listen to music as indicated in Figure 3.



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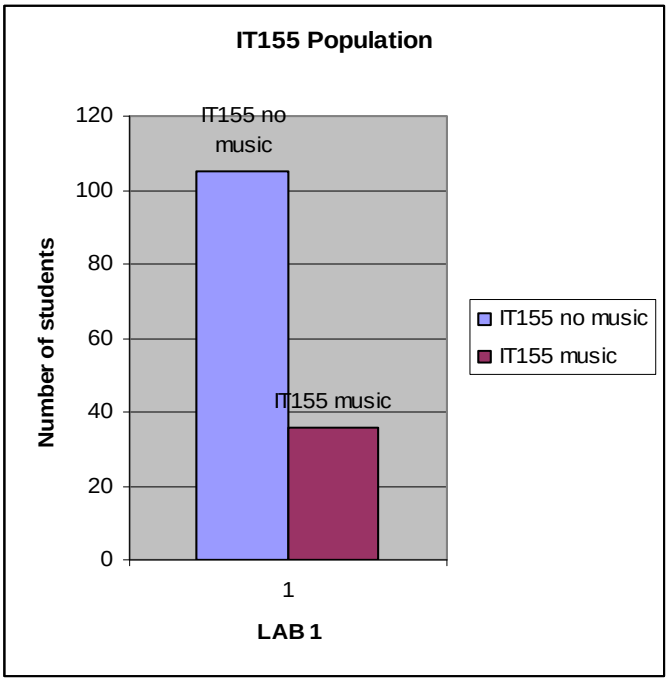


Figure 3

For the second lab which was 2 hours in duration half the population was given the opportunity to listen to music. This time the students that were not allowed music in LAB1 were given the opportunity to listen to music in LAB2. The students that were given the opportunity in LAB1 to listen to music were now not allowed music for LAB2. The total population of music listeners was 118 and 500 students did not listen to music as indicated in Figure 4.

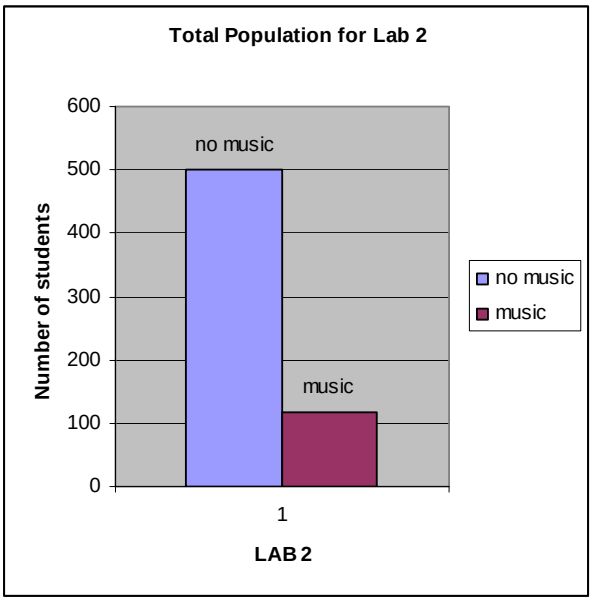
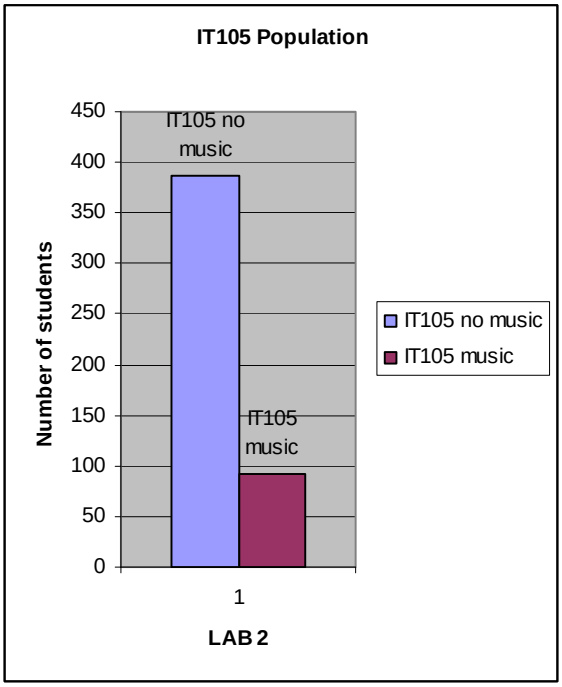


Figure 4

Breaking the population down by course, IT105 had 91 students choose to listen to music and 386 students did not listen to music as shown in Figure 5. IT155 had 27 students listen to music and 114 not listen to music as indicated in Figure 6. Once again, those students that had the opportunity to listen to music but chose not to listen cited music as a possible distraction.



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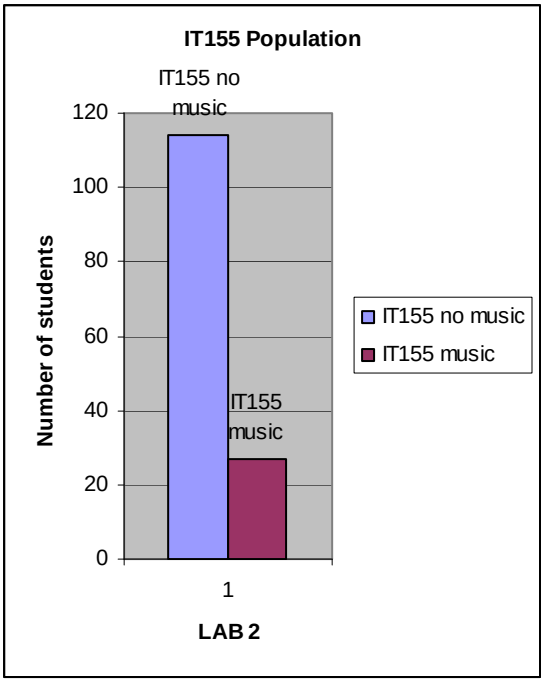

Figure 6

For the third lab, all 618 students were given the opportunity to listen to music. A total of 269 students chose to listen to music for the 3rd lab and 349 students chose not to listen to music as indicated in Figure 7.

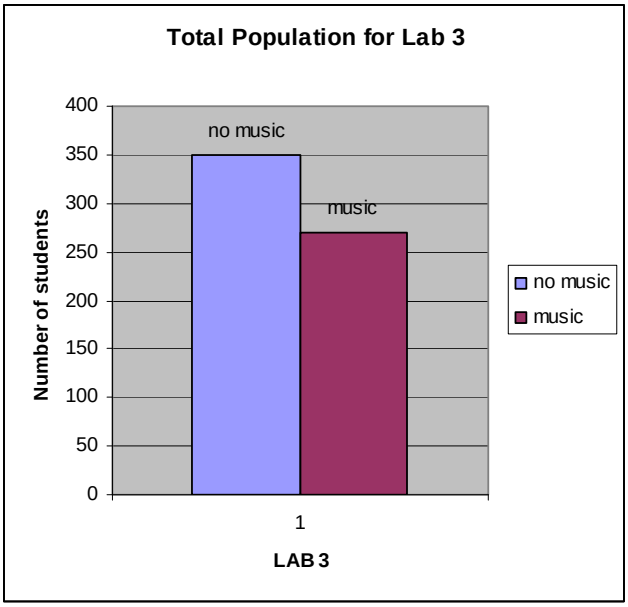

Figure 7

IT105 had 201 students that listened to music and 276 students that did not listen to music as shown in Figure 8. IT155 had 68 students that chose to listen to music and 73 students that did not listen to music as shown in Figure 9.

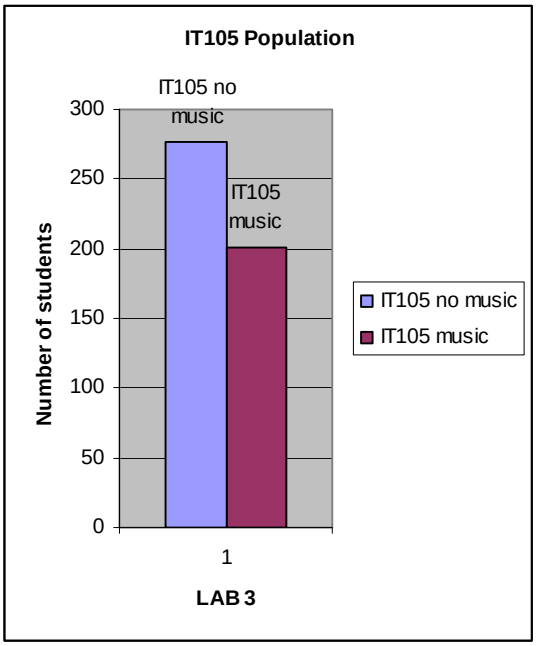

Figure 8

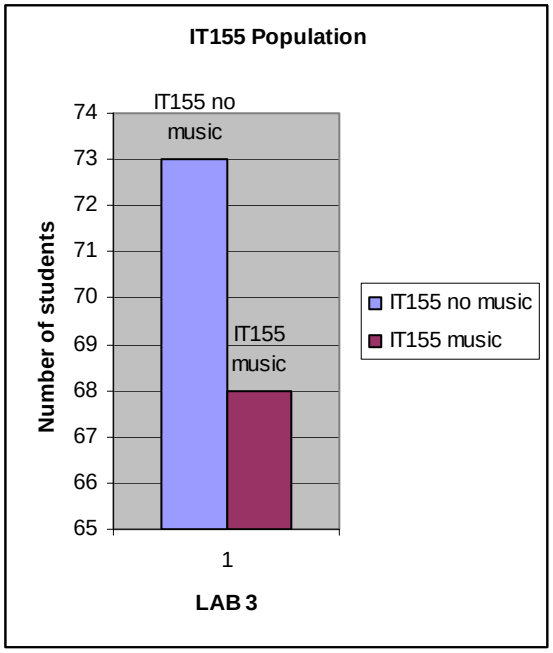

Figure 9

After completing each of the graded programming labs, the students indicated on a spreadsheet whether they listened to music and the type of music. Students were not restricted to listening to only 1 category of music.

Name	UserID	Sect	Music	Classical	Country	Hard Rock	Pop Rock	Rap	Religious	Blues	Other

Later, the students were given a follow up survey on a 5 point Likert scale. Question 6 was not on a Likert Scale.

Strongly Disagree				**Strongly Agree**
1	2	3	4	5

1. I enjoyed listening to music during my IT105 labs
2. I would like the opportunity to listen to music in other courses during graded events
3. I believe music helped me to perform better on the graded IT105 labs
4. Music did not distract me from programming on the IT105 labs.
5. Music makes me feel less nervous during a graded event.
6. Please tell me why you did (or did not) choose to listen to music in labs.

Results:

Figure 10 depicts the averages for IT105 students for all 3 graded programming labs. Students that listened to music for Lab1 and Lab3 had lower averages than those that did not listen to music.

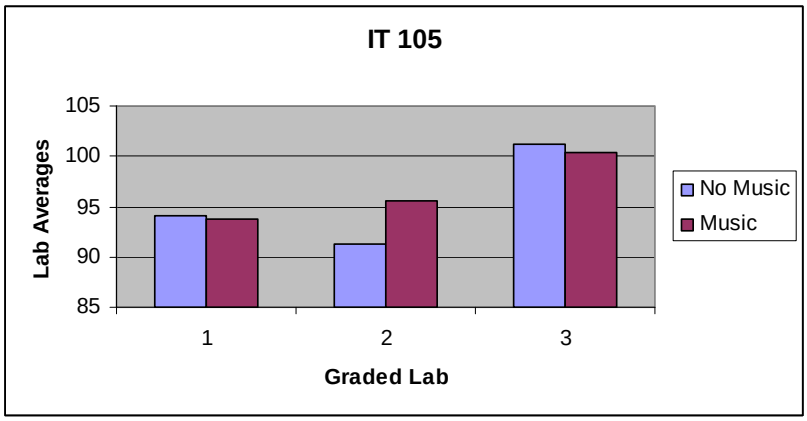

Figure 10 Lab Averages for all IT105 students

Figure 11 depicts the averages for IT155 students for all 3 graded programming labs. Students that listened to music during the programming labs had higher averages than students that did not listen to music.

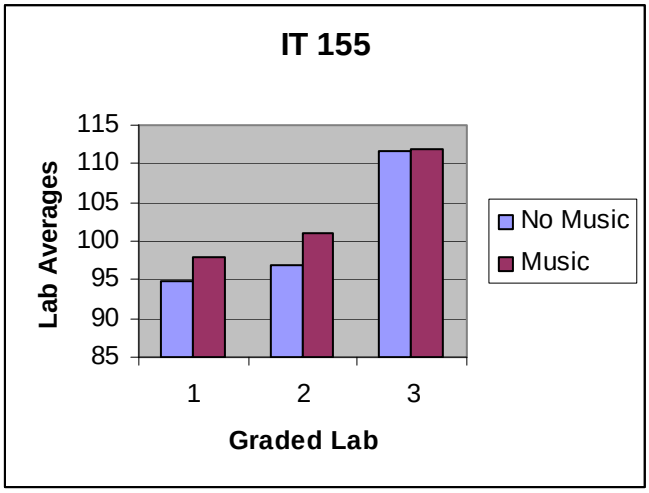

Figure 11 Lab Averages for all IT155 students

The graded labs could further be broken down by section. Each course (IT105, IT155) could be broken down into 4 sections A, D, H and I which corresponded to the time of day they were taught. Varsity athletes took IT105 during D hr. Figure 12 depicts the averages for all 3 graded labs for the D hour Section for IT105. Students that listened to music had equal to or greater averages on the graded labs.

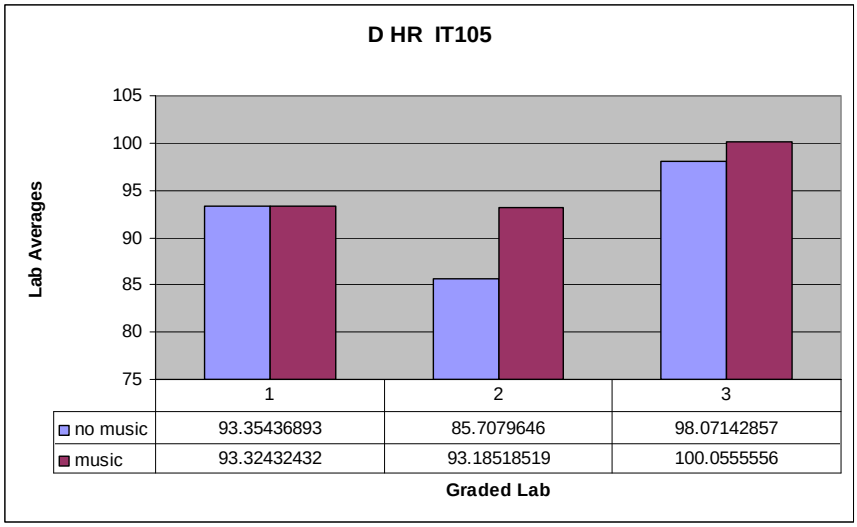

Figure 12 Lab Averages for IT105 students in D hour

Table 1 depicts the results of the follow up survey for questions 1 thru 5 which were administered on a 5 point Likert Scale. The responses for question 6 indicated that music was not selected as they perceived it to be a possible distraction.

	AVG	MIN	MAX	STD DEV
Q1 I enjoyed listening to music during my IT105 labs	3.6	3	5	1.5
Q2 I would like the opportunity to listen to music in other courses during graded events	3.5	1	5	1.5
Q3 I believe music helped me to perform better on the graded IT105 labs	3.7	1	5	1.5
Q4 Music did not distract me from programming on the IT105 labs.	3.5	2	5	1.4
Q5 Music makes me feel less nervous during a graded event.	3.2	1	5	1.5

Table 1

Discussion:

IT105 students did not perform as well with music on the graded labs 2 out of 3 times while IT155 students performed better while listening to music. The inverted-U hypothesis also known as the Yerkes-Dodson law [10] can be applied to the results. The inverted-U hypothesis predicts performance improves on a task with increased emotional arousal up to a point after which performance on the task deteriorates. The optimal level of arousal for a task depends on the complexity of the task. When the task is complex a low level of arousal is optimal. When the task is simple a higher level of arousal will lead to peak performance.

IT105 students that listened to music on the first lab did not perform as well as students that did not listen to music. The first lab was the least complex however stress would be elevated in IT105 students because it was the first time their programming skills were being evaluated. The addition of music added to their emotional arousal levels resulting in a less than optimal response.

For the second lab IT105 students entered the lab with more test coping skills. They had already taken the first lab and they had a better idea of what to expect in the evaluation of their programming skills. The addition of music did not interfere with their abilities to perform. The increased emotional arousal from music improved their performance on the task.

For the third lab IT105 students did not perform as well while listening to music. The third lab was technically more complex. The increased emotional arousal from music interfered with the performance of the complex task of programming. The higher arousal led to poorer performance on the task.

The inverted-U model can be applied to IT155 students as well. IT155 students performed better while listening to music on all three labs. IT155 students had better programming skills. The first two labs were not complex programming tasks. IT155 students were confident with their programming skills and did not feel stress from those skills being evaluated. The addition of music increased their emotional arousal and increased their optimal performance. The third lab was complex and although IT155 students performed better while listening to music the increased benefit was minimal in comparison to the previous labs.

Conclusion:

In this study students were not forced to listen to music. They had the opportunity to listen to music of their choice. The results indicate that those students who chose to listen to music and were not in the honor course had a lower average 2 out of 3 times than the students that did not listen to music. It appears music is a distracter from learning a primary task such as writing Java code.

In contrast, students enrolled in the honors course consistently performed better in the graded programming labs while listening to music. Music was not a distracter. Perhaps students that

have a natural ability or tendency in a task such as programming receive a positive benefit from listening to music.

Athletes consistently performed better on the graded programming labs while listening to music. Studies have shown that music has a positive effect on athletic performance [7]. It appears that in this study athletes could transfer the positive effects of music to other tasks in this case programming.

Future research in this area may include breaking the music down by a single category. In this study students were permitted to listen to music of their choice. Their music choice normally consisted of music from multiple categories which prevented examining the effects of music by music type.

References

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