An Experiment on the Effects of "Accelerated Learning" Classical Music on the Sudoku-playing Abilities of Filipino College Students

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Abstract: In this paper, the effect of Accelerated Learning (AL) classical music of 50 to 60 beats per minute on the ability of Filipino senior-level college students to play Sudoku puzzles was investigated. To do this, Sudoku-playing sessions with or without AL classical music were held, controlling for other factors as much as possible between the treatment and the control group. Statistical tests were performed to measure the performance difference between the two groups, and post-experiment Focus Group Discussions (FGDs) were done to validate the statistical findings. It was found that AL classical music, in general, does not improve the performance of listeners in puzzle-solving tasks; however, exposure to and personal preference for classical music determine if AL classical music would enhance or distract a person while performing cognitively challenging tasks such as puzzle solving. Furthermore, sex appears to be a strong indicator of a person's inherent ability to solve Sudoku puzzles, while the academic course enrolled in is strongly correlated with the speed in puzzle-solving in the presence of AL classical music. While the results of this quasi-experiment offer interesting insights, follow-up studies with larger sample size and longitudinal studies on the long-term effects of continuous exposure to AL classical music is recommended.

Key Words: accelerated learning; puzzle-playing; classical music

1. INTRODUCTION

Rapid and continuous improvements in technology have enabled faster delivery of information to concerned individuals, and extended the network with which people deal business, to the point that keeping up with the information explosion has been a major concern of educators and business owners alike (Pattison, 2001). This phenomenon has underscored the need for radical improvements in assimilating knowledge, both in terms of speed and quantity of knowledge acquired. Among the myriad of learning techniques that have surfaced to address this need, Accelerated Learning (AL) through music has received popular and quite controversial attention. This has been due, mainly to the esoteric origins of the AL, and the wide spectrum of learning rates, ranging from two- and three-fold learning gains, to hundred-fold gains, that AL supporters would normally claim. While the actual achievable learning gains through AL have consistently been a subject of impassioned debates from the highly polarized camps of supporters and cynics of AL, the relationship between music and a relaxed mental state is well recognized (Carlson et al., 2004). And by achieving a relaxed mental state, other benefits can also be attained, such as, regulated heartbeat, lower blood pressure, enhanced immune system (Pattison, 2001), improved brain function, and higher academic performance (Carlson et al., 2004).

1.1 On the Use of Music to Enhance Learning

While a relaxed mental state may be achieved through a variety of ways, i.e. meditation and gentle massage, studies have indicated that it may also be conveniently induced by music (Pattison, 2001). The common notion that music and relaxation are interrelated has made music a common tool in counseling (Bixler, 2001), and a major component in the design and delivery of successful training programs (Pattison, 2001). It was also observed that rhythm seems to be one of the important aspects of music that facilitate relaxation (Carlson et al., 2004). This positive effect of music on mental performance

has already inspired the development of a pedagogical system, popularly known as Accelerated Learning, which was started and popularized by a Bulgarian scientist, Georgio Lozano in the mid-1960's (Hagan, 2002). Also known as Suggestopedia, AL uses music with 50 to 60 beats per minute rhythms to significantly enhance learning and retention. AL practitioners particularly prefer Baroque Music, especially those written by Vivaldi, Telemann and Bach, since this type of music has a slow, restful tempo of about 60 beats per minute, and the instruments (string instruments, violin, mandolin, guitar, and harpsichord) emit soothing high-frequency sounds. It was also found out that active concert music, such as that of composers Mozart, Beethoven, and Brahms, stimulates the brain, likely due to the range of sounds (Pattison, 2001). These gains are possible since AL music can engage the learners' emotions, which enhances memory. Experimental studies investigating this phenomenon already support this claim, indicating positive results on various training and learning programs that use AL techniques. For example, relaxation through Baroque music at the start of sessions of weekly staff meetings and training were observed to help participants be less excited, rowdy, and rude during the training (Pattison, 2001). In another study involving young learners, induced relaxation using a vibroacoustic music chair, for a six-month period, showed significant improvements in reading performance scores of students in an urban third-grade classroom (Carlson et al., 2004). Experimental studies have also shown the positive effects of classical music in language studies, such as in reading comprehension (Holguin-Barrera, 2016), and in learning foreign language (Salcedo, 2002). Another reason why AL has been steadily adopted in learning scenarios is the fact that creative study methods are heavily preferred by active learners over traditional types of learning, which typically appeal only to specific types of learners. It was also reported that participants in staff training strongly favor multimodal methods of training delivery over traditional passive, lecture-based approaches (Pattison, 2001).

There are, however, criticisms to AL that cast a long shadow of doubt on its supposed benefits. One such criticism dwells on the pedagogical foundation of AL itself, as pointed out by Hagan in his expository article: the idea of engaging the left and right sides of the brain to enhance learning may be counterproductive as AL methods may activate parts

of the brain ill-suited for a particular type of learning, i.e. right hemisphere activation is linked to stuttering (Hagan, 2002). Other criticisms question the methodological biases of the studies that support AL techniques, as well as the inherent biases of the researchers studying and promoting AL. Flaws of methodologies, such as incomplete or missing bibliographical entries, some unsupported claims, biased experiments, propagation of known myths in learning, in studies of mainstream proponents (i.e. Lozanov, Ostrander & Scrhoeder, Erland) of AL are evident, thereby casting doubt on the authenticity of AL. Furthermore, the abovementioned leading AL proponents, in the past, have misrepresented their work and have shown bias towards AL in their studies, thus affecting their credibility in the name of fair scientific inquiry (Hagan, 2002). There are also several studies that concluded that background music has no significant effect on cognitive abilities such as those by (Birman & Ferguson, 2022; Harmon, Troester, Pickwick & Pelosi, 2008).

These issues accompanying Accelerated Learning pedagogy, and the multifarious and dynamic interplay of factors that affect learning, highlight the need to conduct a quantitative study of its effectivity when applied in a typical local learning set-up. Various studies have already related relaxing music and increased mental performance induced by a specific type of music, which is Baroque. The question, however, remains: *Is this relationship also true for students exposed in a characteristically Filipino culture?*

1.2 *The Sudoku Puzzle to measure Logical Ability*

Puzzles with simple and easily understandable instructions have long been used in logic tests aimed at measuring the Intelligent Quotient (IQ) of individuals. These tests may be designed to be unbiased towards examinees of a particular age, experience, learned skill, or possession of factual knowledge. Puzzles also measure the mental focus of participants who are asked to perform various mental exercises in order to correctly answer a given question. They come in various forms, designed to measure different mental capabilities such as logic,

Figure 1. An example of an answered Sudoku Puzzle. The shaded boxes contain the given numbers, while the unshaded boxes contain the correct answers (Shorts, 2005).

memorization, visual perception, strategy formulation and mathematical skills, which each puzzle item solvable from within a few seconds to within a few minutes.

One puzzle which serves as a good candidate for measuring the problem-solving and pattern-recognition abilities of participants is the Sudoku puzzle. This numbers puzzle, which became very popular in Britain, Japan and the United States of America, asks the puzzle solver to fill a typically 9x9-sized grid with numbers so that every row, every column, and every 3x3 box contains the digits from 1 to 9, without repeating. Some digits are already placed in the grid to get the solver started. The number and placement of the given digits would determine the level of difficulty of a sudoku puzzle item. Figure 1 below shows an example of an answered Sudoku puzzle rated as "easy". The Sudoku puzzle is a purely logic puzzle and does not require advanced mathematical skills to be able to solve (Shorts, 2005).

2. METHODOLOGY

This study seeks to determine the effect of 50 to 60 beats-per-minute classical music in the mental performance levels of typical Filipino college students. The students' logic levels will particularly be measured in quasi-experiment fashion, by measuring the average time it takes to answer a single puzzle item, in a series of medium-level Sudoku puzzles, first without music, then compared to a set-up wherein the students are listening to classical music with 50 to 60 beats-per-minute, while solving Sudoku puzzles. Profiles of the participants (i.e. age, sex, year-level, and level of exposure to Sudoku), were also noted and correlated with the performance results of individual participants. The puzzles were generated by a computer program that also records precisely how long a student has answered each puzzle item. The participants are given a 15-minute break in between the first and second Sudoku-solving sessions, for them to relax prior to resuming the activity. During the break, they were asked to input their individual profiles in a computer, while Baroque study music is softly played in the background. Classical music continues to be played in the background, in the second Sudoku-solving session. The actual musical compositions chosen to be played for this experiment are listed in Table 1.

It is possible that other factors not mentioned in the introduction may contribute significantly to the experiment results. To capture these factors according to the participants' perceptions, the participants were interviewed, after the session, about their impressions of the activity and what they felt before, and while background music is playing.

Wilcoxon Signed Ranks test was used for quantitative analysis of the quasi-experiment, whereas Spearman's method was used for generating the correlations between profile items and Sudoku-playing ability. Wilcoxon Signed Ranks was chosen over the t-test because of the small sample size, and the uncertainty of the distribution type of the performance scores of the participants. Spearman's correlation was computed, instead of the Pearson's correlation coefficient, because the profile items have different scale values compared to the performance scores.

Table 1. Musical Compositions used in the study

Composition Title	Composer	Running time (minutes:seconds)
Eine kleine Nachtmusik - Romance, Andante	Mozart	5:44
Air (from Orchestral Suite No. 3 in D)	J.S. Bach	4:32
Oboe Concerto in D minor, 2nd movement	J.S. Bach	3:07
"Con molti stromenti" Concerto in do maggiore RV 558 - 2. Andante molto	A. Vivaldi	1:46
Concerto No. 4 in F Minor, RV 297 (Winter) - II Largo	A. Vivaldi	2:01
Concerto per due mandolini in sol maggiore RV 532 - 2. Andante	A. Vivaldi	2:10
Concerto Grosso Sol, OP. 6, N.º 1 - A tempo giusto	G. F. Handel	1:51
Suite No. 1, BWV 1007 - G maj - I. Prelude	Yo-yo Ma	2:32

3. RESULTS AND DISCUSSION

A total of 11 respondents participated in the activity, 7 of which are males and 4 are females. The ages of the respondents range from 19 to 22 years old, with a mean age 20.18 y/o, and a median age of 20 y/o. All are enrolled in technology-oriented courses at De La Salle University – Manila and University of the Philippines – Diliman, and are senior-level graduating students of their respective courses. Seven (7) of the participants consider themselves as "newbies", i.e. have played the game for less than 6 months, while the remaining 4 participants consider themselves as "experienced", having played the game from 6 months to 3 years.

3.1 Wilcoxon Matched-Pair Signed Ranks Test on "Before" and "After" Tests

The experiments resulted in only 4 (or 36.36%) of the participants registering improvements in Sudoku-puzzle solving after having been exposed to classical 50-60 BPM music. Seven (7), or 63.64%, of the participants showed a drop in performance while listening to classical AL music. The statistical significance value of 0.182, based on the Wilcoxon Signed-Rank test, indicates that for this experiment, the null hypothesis that classical AL music does not affect Sudoku-playing performance level holds.

When asked what they thought of the background music being played as they were solving Sudoku puzzles, 4 of the respondents indicated that they got distracted by the music and hence, the music negatively affected their performance. Four (4) of the respondents said that the music was too relaxing that they got careless in answering the puzzles, while 3 respondents felt that the music has no perceived effect on their ability to solve Sudoku puzzles. Among the four respondents who showed improvements while listening to classical music, one reported actually having been disturbed by the sounds, another one reported being disturbed at first but eventually enjoyed the music, while 2 reported having been helped by the music to relax and be focused as they were solving puzzles. It was also found out that 2 students who showed positive impressions on the classical AL music actually preferred listening to classical and other types of relaxing music. The three students who reported being relaxed by classical music in the experiment registered an average of 36.9% improvement in their Sudoku-playing abilities while being exposed in classical music. Those who had negative impressions on classical AL music registered an average of 57.7% drop in performance when exposed in classical AL music. Based on the quantitative results and the follow-up interviews, it can be concluded that music preference determines the actual effect of classical AL music in puzzle-solving activities.

3.2 Correlation tests

Table 2 shows correlation values of Average Time to Solve Sudoku Puzzles, and Profile items such as Age, Level of Exposure to Sudoku Puzzles, Course, and Sex respectively. While age does not determine one's ability to solve Sudoku Puzzles, it can be seen from Table 2 that the level of exposure to Sudoku strongly predicts ($p = 0.001$ for alpha = 0.01) how quickly one can answer a puzzle item in the first try. It can also be gleaned from Table 2 that the level of experience in Sudoku solving, however, does not significantly affect the performance level improvement when exposed to

Table 2. Spearman's Rank Correlation matrix

	Age	SolveTimeNoAL	SolveTimeWithAL	Course	Sex	SudokuExp
SolveTimeNoAL	-0.269	1	0.409	-0.364	-0.837**	-0.837**
SolveTimeWithAL	-0.513	0.409	1	-0.674*	-0.120	-0.598

* Correlation is significant at 0.05 level (2-tailed).   ** Correlation is significant at 0.001 level (2-tailed)

classical music. Curiously enough, it was observed that the course enrolled in is a strong determining factor (0.023 significance for alpha = 0.05) for the average time it takes to solve a puzzle in the presence of classical AL music. This is due to the fact the top two students who registered the fastest times came from courses (BS Electronics and Communications Engineering and BS Computer Engineering, respectively) that are different from the remaining 9 (or 81.82%) participants, who all happen to have same courses (BS Computer Science). Based on the data gathered, sex strongly determines (p = 0.001 for alpha = 0.01) the ability to solve Sudoku Puzzles in a normal try (no interventions), with male participants scoring higher marks compared to the female participants.

4. CONCLUSIONS

This study investigated the effect of Accelerated Learning (AL) classical music of 50 to 60 beats per minute in the ability of Filipino senior-level college students to play Sudoku puzzles. The AL classical music, in general, does not improve the performance of listeners in puzzle-solving tasks. Subsequent personal interviews with participants, however, suggest that exposure to and personal preference for classical music are crucial in the successful application of AL pedagogy in acquiring the focus needed to effectively hurdle a problem-solving task. Sex appears to be a strong indicator in a person's inherent ability to solve Sudoku puzzles, while the academic course enrolled in strongly correlated with speed in puzzle-solving in the presence of AL classical music.

Care was given in choosing the correct method of analysis for the experimental results. The small respondent population size, and the fact that

participants were not chosen in random, might render the conclusions of this paper unrepresentative of all college level Filipino students. The duration of the experiment might not have been enough to conclusively determine the overall effect of AL study music; hence, it is recommended that a long-term study of the effects of music be made, with a larger population of students who belong to a more diverse scholastic and geographical backgrounds.

Previous works have studied the influence of various elements of the background music (BgM), such as the genre (Goltz & Sadakata, 2021), lyrics and language (Vasilev, Hitching, & Tyrrell, 2023), on the performance of learners for specific tasks such as memory, reading and writing, math and abstract reasoning, and linking them to the personality trait of extraversion (Furnham & Allass, 1999), and the respondents' demographics such as gender and age[1]; this study contributes to the current research landscape by measuring the effect of a particular type of BgM on the respondents' performance in a cognitively demanding yet language-agnostic task of problem-solving. Still, more studies should be done to better understand the effects of the ambient environment towards enhancing the individual learners' performance. Some research directions that can be pursued after this study, as suggested by (Cheah, Wong, Spitze, & Coutinho, 2022), include understanding the specific and multiplicative effects of particular types of BgM to tasks that require high-level of cognitive control versus tasks that benefit from a more relaxed cognitive state, and the combinations of these tasks that are typical in everyday-life scenarios.

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[1] Refer to (Cheah, Wong, Spitze, & Coutinho, 2022) which contains a systematic review of literature covering 95 articles on BgM and performance across six different cognitive domains.

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