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Music to our ears: The effect of background music in higher education learning environments

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ABSTRACT

Learning and teaching practice in higher education has embraced various forms of technology over recent years directed at enhancing the learning experience. Background music is well-known to benefit learning in elementary schools, but has been largely ignored in higher education. There is evidence that background music is particularly beneficial for students with previous musical training which is important for educators on audio engineering or similar courses linked closely with music. This work aims to determine if there are merits to background music in higher education and to point towards future work required to give definitive proof.

1. INTRODUCTION

The situation isn't uncommon: as a lecturer drones on at the front of a classroom, some students' eyes become heavy. Others are quickly distracted, thus losing focus. This apparent lack of concentration in higher education learning environments can be attributed to a number of seemingly obvious reasons. Are the students simply not interested in the subject? Does the lecturer have a poor delivery style? Were the students up late the night before and lack energy? Is the learning environment ill-suited for effective learning? These tend to be the go-to conclusions in such circumstances, but what if there's something inherent to how our brains operate that's missing from the picture? Is there a way to spring learners' brains into action without them realizing? An

approach of this kind, if effective, could help promote a healthy learning environment and facilitate deep learning [1].

The question here is whether carefully chosen background music (or noise) has any effect (positive or negative) on the learning environment in higher education. This work details research conducted in this area and attempts to draw a suitable conclusion regarding the potential usefulness of background music in higher education.

Section 2 gives an overview of background music including the effect it has on our brains, how it affects

people with different personalities and how to go about choosing suitable music. This discussion is followed by a review of background music research that has been conducted on different age groups in an attempt to judge the benefits for higher education students (young and older adults). Section 4 focuses on the relationship between musical ability and the effectiveness of background music which is critical to this research as the author's student groups typically have a solid musical background, but many other areas of study do not have students with similar profiles. The paper is capped with a focused discussion in section 5 on the implications of this research and concluded (with suggestions for future work) in section 6.

2. BACKGROUND MUSIC OVERVIEW

Background music is defined as “music intended to be heard but not actively or purposely listened to” [2] and is part of everyday life, whether it's in a shopping center, on a television advertisement, at a sporting event or coming out of someone's headphones as they go about their business. Marketing experts have understood the positive effect of background music for many years, using it to encourage shoppers to buy more products [3], to make diners eat faster or slower [4] and to create positive associations with their product or service [5].

Perhaps a lesser understood and implemented application is background music in the context of a learning environment. Can an application of this sort be carefully crafted to provide benefits to learning as it has shown to do in commercial situations? This section provides the beginning of an answer to this question, exploring the effect music has on the brain and how this can benefit learning and cognition in general.

2.1. Cognitive learning theory

It is well understood that the human mind contains a finite amount of attention resources at its disposal, thus requiring a prioritization of sorts to focus attention on the most important events while filtering or ignoring unimportant received information. This filtering function can largely be attributed to the so called habituation circuit whereby the brain focuses attention on transient-rich stimuli while ignoring more stable stimuli [6]. The need for this capability stems from early human life where focused attention on potential threats (a snapping twig, a threatening howl/roar, etc.) was essential to survival.

Knowledge of the functionality of the habituation circuit leads to cognitive learning theory which suggests that attention resources are limited within the human mind and that attempting to process too many parallel streams of information can lead to overload [7]. This theory focuses on short-term memory, which is very limited, where long-term memory isn't affected. Of course, if new information isn't gathered in short-term memory there is little chance of it transitioning to long-term memory, constituting deep-learning [1], which is essential and highly desirable in education.

This well-proven case of limited immediate parallel processing power in the brain leads to the apparent conclusion that in order to maximize cognitive functionality, distractions (or events that take up some attention) must be minimized. The idea of background music, therefore, has been regarded by a number of experts as detrimental to concentration in learning environments [8].

Fortunately, research hasn't ended at this overly-generalized conclusion. Subsequent investigations discovered that this initial assumption was largely false. In regards to processing within the brain, it was found that speech, background noise and music are processed within different areas of the brain [9]. There are some caveats to this notion, however. There are aspects of background noise (music in particular) that span multiple processing sections within the brain. Vocal music tends to be much more taxing on attention resources since it requires speech processing as well as music processing [10]. Also, the relative complexity of a piece of music is directly related to the amount of processing required. Music with lower complexity tends to draw less attention since there is simply little to process while complex music requires a significant amount of attention, causing a distraction [10].

In the context of the learning environment, background music is known to directly affect a student's mood state. The mood state has a direct effect on a student's ability to learn, positively or negatively [11]. As is the case (from the author's own experience as an educator and as a student) internal motivation to learn is low at times, thus reducing the effectiveness of a given teaching session. In these situations, background music has been shown time and time again to act as an external arousal to boost motivation to learn [8,11]. This must be used carefully, though. Over-arousal is very possible which acts as interference to learning and consequently, decreased performance (Fig. 2.1) [8,11].

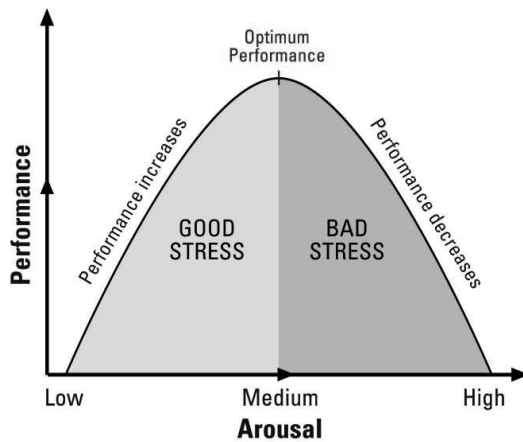


Fig. 2.1 Performance in learning as a function of arousal (external stimulation) level [8]

2.2. Personality profiles

Finding the “sweet spot” when using background music to function as an external stimulant to boost arousal (and thus enhance learning) requires consideration of different personality profiles. In a typical learning environment there will be a mix of different personalities, each which responds differently to arousal in the form of background music. How then, can an educator determine the correct level of music or noise to suit all students?

Research shows that introverts require less arousal while extroverts need quite a bit to facilitate effective learning [12]. Based on this, extroverts tolerate much higher noise levels than introverts. The key is to have background music at a sufficiently high level (both musically and in sound pressure level) so that the extroverts are adequately stimulated while not over-arousing (distracting) the introverts.

2.3. Ideal musical characteristics

There are many considerations concerning musical selection for background music. Genre is typically the starting point when discussing these matters, however research has shown that it’s not necessarily the genre that has a specific effect on people. The effect of music is more down to tempo, pitch, timbre, dynamics, melody and harmony [13].

In regards to mental processing load, a narrow dynamic range (less difference between the quietest and loudest sound in the piece) and pitch range as well as a high repetition rate of melodic and rhythmic phrases are

much easier to process [14]. Additionally, the claim has been made that strong high-frequency content releases endorphins within the brain which causes positive effects to blood pressure and results in positive student behavior [15]. These experiments are still very speculative, however, and need further investigation. Nonetheless, it points to the importance of musical choice for background music.

Since many of these categories are difficult to objectively classify, a number of generalized objective measures of music have been suggested for well-informed musical choices. The first concentrates on the tempo of the piece, measured in beats per minute (BPM). The most effective background music seems to be in the 60 – 120 BPM range, although 70-110 BPM has been identified as the ideal range by some researchers [16]. Alternatively, a suggested 60 BPM tempo is claimed to match the ideal resting heart rate and should work equally well for children and adults [17]. The trend here seems to suggest background music matched to the target resting heart rate of a student is ideal.

Surprisingly, not much discussion has focused on the ideal playback level for background music. One recommendation states that the ideal background music level is 35 dB, which is typically just above the natural background noise level. At 35 dB, the music was experimentally found to maximize alertness, allow for relaxation and in general improve academic performance [18]. This recommendation seems reasonable as levels above this are likely to cause distractions for introverts, who are less tolerable to higher noise levels [12].

A reasonable recommendation for background music choice, therefore, is to choose music, regardless of genre, that is unfamiliar to the students [14,19], and has a lower dynamic and pitch range with a repetitive structure. The music should be instrumental to avoid activating the brain’s speech processing region (which should be used to process the information from the lecturer) with a tempo around an ideal resting heart rate of 60 – 80 BPM. The music should be played at a level of 35 dB, assuming the natural background noise isn’t louder than this. By following this recommendation, the use of background music should generally enhance learning and increase information retention among students [20].

3. AGE-SPECIFIC APPROACHES

The task of choosing appropriate background music, although critical, isn't the central issue of this research since the process has been well-researched and good practice is now well-known and accepted. The question of how student age plays into the effect of background music, on the other hand, is a fairly disjointed area of research where only certain age groups have been the subject of investigations, leaving a number of questions regarding other ages. This section aims to collect information on what is currently known about the effect of background music on different age groups in an attempt to point towards a clear recommendation for applications in higher education.

3.1. Children and teenagers (elementary school & high school)

A considerable amount of research has focused on the effects of background music on young school children (5 – 13 years old). The investigations focus on keeping the students' attention and reducing unsociable behavior. One study conducted in an elementary school lunchroom used soothing music in an attempt to reduce conflicts and aggressive behavior [21]. This technique worked very well with reports of over 1/3 decrease in conflicts and a generally lower noise level in the lunchroom. Additionally, this work reported success in using the Lozanov method of suggestology, whereby background music is combined with softly spoken information. This technique brings students to a concentrated state of mind and has been shown to cause them to absorb information at a higher than average rate [21].

Another in-depth study investigates background music in relation to students' classroom performance. The findings strongly indicate that task performance increases significantly with background music which led to strong academic achievements in the long term [22].

A report by the U.S. National Advisory Mental Health Council in 1990 noted that 15-22% of school children have some form of mental health issue, which limits learning. The report notes that background music clearly improves the situation and found that it was surprising that it is rarely used in practice [23].

There is an increased flexibility in using background music with young children since they've had less an

opportunity to associate pieces of music with events, so they are much more likely to extract the intended music-based emotion to foster healthy learning [24]. This allows for a much broader selection of music and can allow teachers to keep things "fresh" by regularly changing the music selection.

3.2. Young adults (college and university)

Unlike with younger students where there is a wealth of information supporting background music in classrooms, there is nearly no information regarding its use in college and university settings. A very dated piece of research that appears to have never been followed up, suggests that the effect of background music decreases with increasing student age [25]. This claim seems to be more rooted in opinion than actual scientifically-proven fact.

A counter to this negative view of background music for older students is not necessarily formal research, but a program was put into place at the University of Massachusetts – Dartmouth which was inspired by the research based on younger students [26]. The program is called "Jazz for Success" and is run during orientation lectures at the university to help ease new students and to help them retain the vast amount of new information. The program appears to reduce stress levels and gives the new students a more positive approach to learning at university level [26]. This program does have its drawbacks, however, since the musical selection is limited to jazz (based on the preferences of the program leader) and is not implemented in everyday classrooms. With this in mind, it is difficult to ascertain whether background music is indeed effective for older students.

3.3. Adults (working age)

Existing research concentrating on background music for working-age adults is even more limited. There is a fair amount of literature on the use of music therapy to improve an adult's state of mind, but this is outside the workplace or educational arena. The work that does exist focuses on the negatives of noise in the workplace (phones ringing, background conversations, etc.) and how adults find it hard to habituate to these noises, thus causing a decrease in concentration and overall work output [27].

3.4. Adults (retirement)

Interestingly, there is a wealth of information concentrating on the effect background music has on the elderly in terms of comprehension and information retention. Although this age range is well-beyond the typical student age, there may be some parallels that can be drawn between the elderly and young/working-age adults, where there is a lack of information.

Nearly all studies conclude that background music improves cognitive ability across the board for the elderly [8,28]. Although the elderly surely lack the memory capabilities of young people, they retain the emotional connection that helps drive young students to better academic performance when aroused. This lasting emotional response allows background music to have the same effect whereby working memory capacity has shown to increase and retention of new information is much easier [28]. In some cases with dementia sufferers, in fact, background music has proven to temporarily awaken their memories to the operational level of their younger days [28]. The key difference here is that the elderly require music they are familiar with for the effect to work as opposed to younger people where it is beneficial to have unfamiliar background music [8,14].

4. RELATIONSHIP TO MUSICAL ABILITIES

An important question concerning the effectiveness of background music in education is whether prior musical training enables greater benefits in a typical learning environment. Although research hasn't been carried out specifically looking at background music effects versus musical ability, there is a fair amount of literature concentrating on prior music training and academic performance which is useful for this study.

Music is processed in the phonological loop in the brain. Research shows that trained musicians have an enlarged left temporal lobe (where the phonological loop is located) resulting in an increased response to musical stimuli [28]. This idea was put to the test with some young students where they were split into two groups: one a control group where they received no musical training and the second where the students received 40 minutes of musical training every day for seven months. The same teacher taught both groups and the musical training was to listen to music, not to perform. The musically trained group received 15% better marks on their academic tasks than the control group.

Interestingly the researchers suggest that it is pitch discrimination that allows musicians to more effectively collect information and retain it (perhaps a strange form of learning a song) [17].

Another study seems to support this conjecture, stating that it is possible that long-term (lasting) benefits in increased cognitive performance are directly related to musical training. The work found that these traits attributed to musical abilities were unrelated to age or general intelligence, which is central to the current investigation [29].

5. DISCUSSION

Choice of background music and its effect on groups of different age and musical ability has been surveyed, but the question still remains: does background music positively affect the cognitive performance of higher education students? As the author's core student groups are from musical backgrounds, it is of specific interest to determine if background music is worth implementing for their benefit.

Clearly, there are benefits to background music in young students and the elderly. The difference is that young students need unfamiliar music to avoid existing biases while the elderly require previously-known music to best unlock the emotional response (and related cognitive performance) from their younger years. Considering the lack of information regarding young and working-age adults, this information may still be used to construct a recommendation for background music in higher education.

The basics fall into line with the previous suggestions from section 2.3. Music should be instrumental, have a low dynamic range and be on the slower side (60 – 80 BPM). Playback needs to be just above the background noise of the room (by perhaps 6 dB or so), giving an estimated playback level of around 35 – 40 dB. Specific music choice is slightly unclear. The research shows that young students need unfamiliar music while the elderly need the opposite. Considering most students are closer in age to the young students and are likely to be easily excited (and distracted) by familiar songs, it isn't unreasonable to recommend unfamiliar musical selections. The music should be changed regularly to avoid a diminishing effect with time and should allow for adjustments based on regular student feedback (in the initial implementation period especially). Considering how this will affect musically-inclined

students, the research suggests it will be more effective and should increase student performance (which may be especially useful in technical subjects that these students find daunting). The background music should benefit all students, regardless of musical ability.

6. CONCLUSIONS & FUTURE WORK

There is a huge amount of information to consider when deciding to implement background music in a higher education setting. The lack of knowledge on its effects on young adults causes some guesswork to be necessary at this stage. This naturally highlights the need for future work to study background music's effect on higher education students.

Even with this gap in knowledge it is clear background music benefits nearly everyone and even more so for musically-inclined students. Studies show that it increases cognitive ability, especially with information comprehension, retention and critical thinking. It is clearly a benefit to the educational environment and should be trialed at the higher education level.

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