Studying with Music:

An Examination of Cognitive Influences on Encoding with Background Music

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Abstract

The purpose of this paper is to synthesize and assess existing literature on memory encoding and other cognitive processes to determine the potential benefits and drawbacks of studying with music. This paper examines and discusses the results of past studies on aspects such as context dependent memory, music's impact on mood, state dependent memory, the Yerkes-Dodson law, and the seductive detail effect. How to utilize music in a way that is the least distracting to study ability is also examined, and the idea that studying with music may offer the least hinderance to memory encoding only when it is typical, familiar, slow in tempo, low in intensity, and low in complexity is highlighted. Based on the benefits associated with studying with music and because of how potential detrimental effects can be mitigated and controlled, background music is recommended as a beneficial tool to use to enhance time spent studying.

Introduction

When taking an exam, students are unlikely to be in the exact environment in which they spent much of their time studying. They may be in the same seat in the same classroom in which they initially learned the information, but the time spent studying the material outside of class time is likely to be in a different environment (e.g. in a library, at home, in a café, etc.). Studies relating to context dependent memory have highlighted the potential detriments of encoding information in certain contexts and retrieving them in different ones. While the context present during retrieval cannot be controlled in such a way that would completely mimic the environment during encoding, certain contextual cues can be manipulated to either positively or negatively impact ability to accurately recall information. One such contextual cue relates to background music. Background music is a common method of enrichment students use to enhance their time spent studying. There remains much debate as to whether background music offers more disadvantages to a student than advantages. To understand the impact of background music on memory, the encoding specificity principle will first be defined, and context dependent memory (as aforementioned) will be discussed in light of this principle. Music's influence on mood will then be examined which will lead to a conversation on state dependent memory as well as the Yerkes-Dodson Law. Lastly, the deleterious effects of music as a distraction to study ability and how to minimize those distracting qualities will be discussed. This paper will conclude with a conversation on why background music should be utilized as a beneficial study tool based on the exploration of this literature.

The Encoding Specificity Principle

The encoding specificity principle refers to the idea that the contextual cues present during encoding (of episodic memory) can assist in the retrieval of those memories if those same cues are present during recall. Under this principle, context dependent memory is understood as memory related to environmental contextual cues (location, smell, sound, etc.). Another important aspect of this principle is state dependent memory—a type of memory that relates to the mental and physiological states of individuals during encoding and retrieval. The encoding specificity principle is important to consider, as background music can influence the environmental context as well as the physical and mental states of studying individuals.

Context Dependent Memory

Context dependent memory refers to how the circumstances present during encoding (e.g. physical environment, smell, lighting, etc.) can make it easier to retrieve the memory should those circumstances be the same during retrieval.

An example of this effect involves a study from 1975 where two researchers—Godden and Baddeley—performed a study assessing participants' ability to recall information in the environment in which they originally learned the information compared to in an alternative environment (either on land or underwater). The findings of this experiment showed that information recalled in the same environment in which it was encoded led to significantly better results—individuals performed better when they retrieved information in the same conditions they encoded it in (either underwater or on dry land) (Godden & Baddeley, 1975). The results of this study showed how influential the context in which we encode material can be on our ability to accurately remember that information at a later date.

The context present in a testing environment (such as in a classroom) is not likely to match that of the study context (such as in the library). Although being in the same environment one encoded information in is helpful to aid in recall, there are still contextual cues that can be controlled across different environments. Researchers have performed studies analyzing the effect of context dependent memory considering more specific contextual cues outside of an overarching environment. One such study looked specifically at the effect of background music and its role in remembering—researchers Balch, Bowman, and Mohler (1992) tested the idea of music-dependent memory using a delayed or immediate word recall test. They found that context dependency was significant for the immediate recall of those words (between same cue and different cue recall). Retention interval did seem to play an important role, however, as delayed recall did not show the same cue effects. It is also worth noting that the music that resulted in significantly lower immediate recall involved altered tempo (rather than genre) and having no cue (instead of a different cue) did not seem to affect recall ability. The researchers did address that the lack of effect found in delayed recall may be partly due to factors such as the presence of different contextual cues (i.e. a pleasantness rating scale) during the word-presentation phase that were not present during the recall phase.

It is worth noting that other studies have discovered significant effects in delayed recall and music-dependent memory. An example of music dependent memory being shown in delayed recall involves a study from Smith (1985). This researcher performed two experiments testing the effect of background music on ability to learn and remember information (with a delay of 48 hours between encoding and recall). He found that recall was better if the acoustic background music present during encoding was reinstated. In a classroom testing environment, it is unlikely that the same background music used during a study period would be reinstated. Based on this

information, it may seem as though background music is simply not a beneficial tool to have when trying to memorize information, but that is not necessarily true. Testing online may offer the opportunity for background music in one's personal testing environment. In these conditions, it may be useful to utilize the same background music while studying and testing.

By looking at the impact music can have on mood—and thus on performance—one can see how the effect of music goes beyond the contextual impact and can influence an individual's mood to better encourage study ability in other ways.

Music's influence on mood

Music has been shown to have effects on mood and has been used by some as a method of emotional regulation. Music's ability to impact mood does seem to have academic standing. Researchers Ferguson and Sheldon studied the potential for positive music to act as a method of inducing happiness, and they found that participants who were assigned positive music (in an effort to intentionally induce happiness in themselves) did report higher positive mood than participants who were assigned not to try and become happier (2013). This effect highlights the impact positive music can have on mood when it is intentionally used by the individual as a way to improve such.

Positive mood has also been associated with the enhancement of certain functions of memory and cognitive ability. For example, individuals in a positive mood performed better than those in a negative or neutral mood when learning rule-described categories (categories that can be readily defined) (Nadler et al., 2010). The findings of this study go along with the idea that mood can influence cognitive flexibility—as was highlighted in the theory discussed in Ashby and colleagues' article (1999). These researchers note that positive affect can beneficially impact

creative problem-solving ability as well as working memory. Nadler and colleagues (2010) showed the potential benefits positive affect may have on cognitive ability—specifically how positive mood can encourage better performance in areas that require flexibility (such as through explicit learning). With this in mind, it may be useful to use music as a method of inducing positive mood when studying/working through material that is dependent on creativity/flexibility.

There have been other studies that have revealed more information on how upbeat music can lead to improvements in processing speed as well as declarative memory performance. Bottiroli and colleagues discovered that the presence of upbeat background music was able to improve the processing speed of older adults working on cognitive tasks. Interestingly enough, declarative memory appeared to be positively impacted by downbeat music just as it was by upbeat music (Bottiroli et al., 2014). These findings show how music can impact mood, which can positively influence performance in certain areas of learning and processing, and that music (both upbeat and downbeat) has the ability to increase performance related to explicit memory. It is important to note that this study focused on older individuals, however, and so the results are not as easily generalizable to those under the age of 60 (as the participants ranged from 60-84 years old).

State Dependent Memory

State dependent memory, like context dependent memory, holds that the contextual cues present during encoding can affect an individual's ability to remember information at a later date. The main difference is that state dependent memory refers to the physical or mental state of an individual and not to the environmental context present during encoding and recall. Knowing

that music can influence mood, it is clear how music may impact state dependent memory (as it can influence the mental state present during the encoding of information). Music can also impact the physical state of an individual, however.

Music has been shown to influence certain physiological responses such as heart rate, skin conductance, and blood pressure (Deckers, 2018). Listening to softer music with slower tempos offers the opportunity to reduce physiological arousal levels while energetic music can heighten them (Dillman, Carpentier, & Potter, 2007). Situations high in collative variables (involving items high in novelty, complexity, and incongruity) can also heighten arousal (Deckers, 2018). Music high in collative variables may heighten arousal levels and impact physiological responses, which can create those physiological cues during encoding. It is worth noting that a testing environment may be one of heightened physiological arousal too, however, as stress can also heighten levels. This would be a benefit to listening to music high in collative variables (as it can create similar physiological states that may offer cues for state dependent memory), but it is important to note the upcoming section on distractibility and processing fluency. Music high in these variables has the potential to increase distractibility and subsequently decrease comprehension of material.

Controlling arousal levels with music can also help individuals obtain a more optimal level of arousal as proposed by the Yerkes-Dodson Law.

The Yerkes-Dodson Law

The Yerkes-Dodson Law is the term used to explain how varying levels of arousal can produce optimal performance on varying tasks. The Yerkes-Dodson law operates on the basis of an inverted U relationship between performance and arousal (Yerkes & Dodson, 1908). This law

would predict better performance when an individual has moderate levels of arousal when working on a moderately difficult task. When learning difficult information, on the other hand, individuals would more likely benefit from low levels of arousal. As mentioned earlier, music is able to affect arousal and can directly impact physiological responses like heart rate and blood pressure (Deckers, 2018). This means that music may be used as a way to help heighten or lower arousal (such as listening to fast-paced music or slow-paced music) to help individuals reach an optimal level of performance when studying depending on task difficulty.

With those potential benefits in mind, it is important to note that there are times when music can distract individuals and cause them to comprehend material less effectively.

When Music is a distraction

A study performed by Thompson and colleagues has shown the deleterious effects that the tempo as well as the volume of music can have on reading comprehension. These researchers allowed participants to read a passage of material while listening to background music (with conditions ranging in tempo and intensity). After reading the passage, participants were then given a short multiple-choice quiz to test their comprehension of the material. The researchers discovered that the higher in intensity and faster in tempo, the more disruption there was to the participant's reading comprehension (Thompson et al., 2011). The findings of this study highlight the potential detriments studying with music that is both fast and loud can have on an individual's ability to fully comprehend the material they are studying—pointing to the importance of having a slower and softer background music present when studying.

In another study testing the effects background music may have on phonological short-term memory, researchers found that vocal music was more disruptive than purely instrumental

music on short-term memory performance (Salame & Baddeley, 1989). Another experiment within that study found that the condition of unattended speech was also more disruptive than instrumental music. This was further shown by researchers Martin, Wogalter, and Forlano (1988), who found that unattended speech interfered with reading comprehension (and music did not). Knowing this, it may be beneficial to use background music (mainly instrumental) when reading study material in an environment where unattended speech is present; tuning this speech out with music may be less disruptive on short-term memory than not using this resource.

Processing fluency is also an important aspect to consider. This refers to how smoothly information is able to be processed based on familiarity, typicality, and symmetry (Deckers, 2018). Listening to music that is low in novelty or complexity (such as simple instrumental music) will be higher in processing fluency which may take up less working memory. Even lyrical music may offer higher processing fluency if it is high in familiarity. Listening to music with such predictability has the potential to provide less distractibility as the stimuli is easy-to-process. Based on this, it may be better to choose predictable/familiar potential background music that is low in complexity.

This information is also in line with what is known about the seductive detail effect.

Seductive Detail Effect

The seductive detail effect theorizes that seductive (or irrelevant) details can worsen learning by adversely affecting cognitive load. With this theory, some have hypothesized that background music may adversely affect an individual's ability to learn information due to the extra strain put on working memory (the workbench of active memory). Researchers Lehmann and Seufert (2017) looked to find the potential impact background music has on learning with

regard to working memory capacity. Their results favored the seductive detail assumption as they found that those with higher working memory capacities were able to learn information in the presence of background music better than those with more limited capacities. With this in mind, some individuals may be better able to work with music higher in collative variables than others with more limited working memory capacities, as they may be capable of processing more information in that workbench. In any case, simple and familiar background music still seems to be a better choice for lessening the cognitive load on working memory capacity to encourage better learning.

Conclusion

The benefits and disadvantages of studying with music are difficult to parse out without fully recognizing the massive differences between not only the individuals, but also between the different forms of music they could be listening to. The effect music has on learning is further made difficult to pin down as a result of varying results depending on slight differences in testing and the lack of studies available in the present.

Based on past research highlighting the potential positives and negatives associated with studying with music, I would recommend using background music as a study aid. I take this stance largely because of its potential impact on mood and arousal—and thus on certain aspects of cognitive performance. Because music can be used as a method of emotional regulation, it has the potential to elevate one's mood to encourage performance on material that requires creativity and flexibility, and it has the potential to heighten processing speeds (Ashby et al., 1999; Bottiroli et al., 2014). The use of music as a way to heighten/lower arousal levels may also be useful in order to help individuals reach a state conducive to optimal performance as theorized by the Yerkes-Dodson Law. Background music can be a beneficial tool if used to control mood and arousal in order to positively influence cognitive ability while studying.

Although there are detrimental effects associated with studying with music, the positives still outweigh the potential negatives because of how these effects can be controlled and mitigated. The detrimental effects from studying with music can be greatly lessened when music is slower in tempo, softer in tone, non-lyrical, and high in familiarity. Songs that are louder, faster, more complex, and lyrical can increase distractibility and can lessen comprehension of material. Because of this, I recommend music that is gentle, instrumentally focused, and familiar to the listener. Furthermore, I would recommend using background music as a way to block out

free speech that may be present in a busy study environment. Free speech has been associated with distracted learning, so non-lyrical music can be a useful tool to help lessen those more distracting sounds present in the environment.

Although state dependent memory and context dependent memory can create unique contextual cues, music is still a useful tool to utilize while studying. Both state and context dependent memory can be beneficial if the music is able to be reinstated in the testing environment (as in some cases regarding online schooling). It is also worth noting that the stated effects of context-dependent memory vary across studies, and music-dependent memory did not even have a significant impact on delayed recall in Balch and colleagues' study (1992).

Based on these reasons, I would recommend studying with music. Particularly, I recommend using music that is low in complexity, high in familiarity, slow in tempo, soft in tone, non-lyrical, and otherwise low in collative variables (unless being used specifically to heighten arousal). Despite the potential for background music to create contextual cues unique to the encoding specificity principle, the effects do not seem to be profound enough to warrant avoiding background music. Furthermore, the benefits associated with regulating mood and arousal (and thus positively impacting cognitive performance) seem to outweigh the potential downsides. Because of these factors, I recommend utilizing background music as a way to enhance time spent studying.

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