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The Effects of Background Music on Primary School Pupils' Task Performance

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SUMMARY *Research on the effects of background music has a long history. Early work was not embedded within a theoretical framework, was often poorly conceptualised and produced equivocal findings. This paper reports two studies exploring the effects of music, perceived to be calming and relaxing, on performance in arithmetic and on a memory task in children aged 10–12. The calming music led to better performance on both tasks when compared with a no-music condition. Music perceived as arousing, aggressive and unpleasant disrupted performance on the memory task and led to a lower level of reported altruistic behaviour by the children. This suggests that the effects of music on task performance are mediated by arousal and mood rather than affecting cognition directly. The findings are discussed in relation to possible practical applications in the primary school and the home.*

Introduction

The effect of music on the moods, emotions and behaviour of both individuals and groups has been noted throughout history. A number of writers have discussed the functions of music (e.g. Merriam, 1964; Gaston, 1968), while others have researched both the physiological and psychological effects (for reviews, see Radocy & Boyle, 1988; North & Hargreaves, 1997; Hallam, 2001a). As a result of this research, music has come to be considered as lying on a continuum from highly stimulating and invigorating to soothing or calming (Gaston, 1968). There is strong evidence from a variety of sources that people respond differently to stimulative and sedative music (Radocy & Boyle, 1988; Hallam, 2001a). In the modern Western world, where music is readily available to everyone through radio, recordings, TV and videos and where recorded background music is routinely played in many public places, the need to understand the effects of music on our behaviour and cognitive processing has become increasingly important. While, research has been undertaken on the effects of music on a variety of activities, it has been relatively unsystematic and much of it has been inconclusive. This is, in part, because music can be

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processed in different ways (Hallam, 2001a). While there may be general trends in our responses to stimulating or relaxing music, these are overlaid by individual cognitions which may mediate the immediate effects, for instance, associations of particular pieces of music with particular events or dislike of particular musical genres.

With regard to children, we know little about the extent to which they are exposed to music in their everyday lives or its effects on them. Given the overall consumption of music within the wider community, we might expect that their exposure is substantial (Hallam, 2001a). We know that in the adolescent years music becomes increasingly important, with most teenagers listening to music for approximately three hours a day, its role being perceived in relation to portraying an image to the outside world and satisfying their emotional needs (North *et al.*, 2000). We also know that much studying undertaken at home is accompanied by music or the TV playing (Patton *et al.*, 1983; Kotsopoulou, 1997). What is as yet relatively unexplored is the effect that the music may have on behaviour or task performance in younger children.

We might expect that the effects of music on the behaviour and task performance of children, unlike those of adults, would follow predictable trends, as they would have had relatively little opportunity to acquire specific associations between particular events and specific pieces or types of music. We would expect their responses to be based on relatively primitive mechanisms. This is supported by evidence that different types of music can have differential impact of the physiological responses of premature infants (Lorch *et al.*, 1994) and the activity levels of young children aged 3 to 4 (Reiber, 1965). Studies of children with special educational needs have also shown that the introduction of background music into the classroom setting has a calming influence on hyperactive children and improved performance on mathematics tasks (Scott, 1970). Hallam and Price (1998) found similar effects of music on children with emotional and behavioural difficulties. Several studies have reported a music-induced decrease in activity level in ADHD children (Cripe, 1986) and mentally retarded children (Gregoire, 1984; Reardon & Bell, 1970), while Savan (1998) has demonstrated improved behaviour and a greater concentration on school work when Mozart was played during the science lessons of ten children with learning, emotional and behavioural difficulties.

Other studies have explored the effects of music on children in mainstream schools, but the type of music played and the ways in which it was expected to influence behaviour have not always been specified. Mitchell (1949) compared performance on a comprehension task of listening to a variety show, a musical show or silence and found that reading achievement was not adversely affected by the musical programme. In a later study, Hall (1952) found that performance on reading comprehension tests was significantly improved when background music was playing. There were also 'settling down periods' at the beginning of the morning and afternoon sessions and a mid-afternoon fatigue period when music was of greatest assistance. However, no details were given of the kind of background music which was used. Not all of the research has found positive

effects of background music. Fogelson (1973), assessing the reading test performance of 8th graders when an instrumental version of Mantovani's 'Favourite Show Tunes' was playing, found that performance was adversely affected for all the students. The music had a more detrimental effect on the children of higher ability than those of low ability. Kiger (1989), studying older pupils aged 15 years who read a 1450-word passage on Japanese history with high or low information load music or no music in the background, found that reading comprehension scores were significantly higher in the low information load condition than in the silent or high information load conditions.

Other work has focused on tasks which involve memory. Henderson *et al.* (1945) explored the effect of music as a source of distraction during the taking of a test. Type of music and the complexity of the testing material both affected performance. Mowsesian and Heyer (1973) studied the effects of music on test-taking in 15 year olds using a control and groups listening to rock, folk, symphonic music and opera. They were tested on mathematics, language and spelling and also completed a self-concept of ability scale. The music had no significant effect on performance.

Explanations of the effect of music on learning and behaviour have tended to look for explanations in terms of arousal and mood. The Yerkes–Dodson law states that the arousal level of the individual increases performance up to an optimal level beyond which over-arousal leads to a deterioration in performance. The law also states that the deterioration occurs more quickly when the task to be performed is complex or under-learned. A simple task will require a higher level of arousal for concentration to be maintained. Stimulating music is expected to increase arousal and improve performance on simple tasks but, if the task is complex, the level of arousal may become too great and performance deteriorate. Arousal levels may also be linked to personality factors (Eysenck, 1967) and are responsive to a range of environmental stimuli. They are not consistent over time. Some research has shown that positive emotions may adversely affect cognitive reasoning tasks (Oaksford *et al.*, 1996), so music inducing a positive mood might interfere with task performance.

The research reported here attempts to establish the effect of music on task performance in 10–12 year olds, while clearly defining the nature of the musical content as perceived by the listeners in relation to its potential to evoke particular states of arousal. In the first study, pupils' performance on arithmetic tasks was compared in a calming, relaxing music condition and a non-music condition. In the second study, an attempt was made to disrupt studying by comparing performance in three conditions, two as before, the third with music perceived as arousing, aggressive and unpleasant. After completion of the second task, pupils were also asked to respond to materials indicating their reported level of altruism to explore the possible effects of music on their mood.

Study 1

The Music

The music for the study was selected from that suggested by Giles (1991) as 'mood calming' and included selections from Walt Disney films and other childrens' music. Specific pieces were chosen by playing short excerpts (60–90 seconds) to a group of children who were asked to assess each piece on three dimensions happy/sad, calming/exciting and like/dislike. The criteria for inclusion of any individual piece of music was that it should be interpreted as calming by the majority of the pupils.

The Sample

31 children took part in the study. They were aged 10 to 11 in year 6 in a junior school in the London area. They were randomly allocated to two groups, a music group and a non-music group. The teacher reported that in maths lessons they were normally quiet and industrious. They had also had some previous experience of working with background music in creative subjects.

The Task

The class teacher selected the arithmetic problems to be undertaken to consolidate work already covered in the syllabus and to be within each pupil's level of competence. The problems all concerned fractions.

Procedure

The mathematics sessions took place during the first lesson of each day on four consecutive days. For the first 15 minutes of each period, Group B (no music) completed their arithmetic work in one area of the room. This was followed by general mathematics work. During this time Group A worked on general mathematics tasks. Later in the session, group A (music), completed their arithmetic work for 15 minutes while group B continued with general mathematics. This pattern was repeated over the four sessions with the order alternated so that no group had a practice advantage. The pupils were instructed to work independently on their arithmetic work without talking to other pupils and to sit quietly and complete correctly as many of the maths problems as possible in the 15 minutes. If the pupil required teacher instruction to complete the work, his/her score was discounted from the analysis. In each session, for each individual, the number of attempted maths problems, the number correctly completed and the accuracy rate were recorded.

TABLE I. Mean number of problems completed with and without music

	With music		Without music		
	Mean	SD	Mean	SD	Significance
Day 1	37.5	9.23	28	9.3	0.007
Day 2	32.5	12.6	24.8	10.7	0.05
Day 3	33.8	7.8	28.4	6.1	0.026
Day 4	36.4	7.9	29	11.43	0.03

Results

An examination of the mean number of problems completed during the 15-minute session revealed that the mean for those listening to the background music was 34.9 (SD = 7.7) problems and without background music 27.3 (SD = 7.8). This difference was statistically significant ($p = 0.02$). When performance was considered for each day separately, this pattern was repeated (see Table I).

When the number of correct problems was considered, the overall mean with background music was 27.8 (SD = 7.5) and without background music 23.5 (SD = 2.8). This was not statistically significant ($p = 0.12$). However, there was some variability within the sessions (see Table II).

A percentage accuracy level was established by taking the number of correct responses and dividing them by the number of attempted responses. The percentage accuracy rate with background music was 84% and without background music 80%. This difference was not statistically significant (see Table III). However, there was a significant difference in the variance of the two sets of scores. With background music, the standard deviation was 12.7, without background music it was 5.57 ($p = 0.025$). There was considerable individual variation in the level of accuracy when music was being played.

TABLE II. Mean number of problems solved correctly with and without music

	With music		Without music		
	Mean	SD	Mean	SD	Significance
Day 1	28.8	10.2	19.7	8.1	0.01
Day 2	22.7	12	19.9	10.3	NS
Day 3	26.6	11.4	25.8	6	NS
Day 4	29.3	7.2	24.4	11.5	NS

TABLE III. Percentage accuracy level with and without music

	With music		Without music		
	Mean	SD	Mean	SD	Significance
Day 1	76.9	18.3	73.8	14	NS
Day 2	71.9	25.1	79	16.5	NS
Day 3	77.4	21.57	90	5.9	NS
Day 4	81.4	15.5	80.7	12.7	NS

Commentary

The findings from this study suggested that background music could enhance the speed of working on mathematics problems. It did not lead to greater accuracy. This supported the arousal hypothesis of music's effects on task performance. It further suggested that children who were normally well behaved and concentrated on their work could further improve their rate of working when appropriately calming music was being played. These findings prompted a further study to explore whether it was possible to disrupt learning by playing music which was perceived as arousing, aggressive and unpleasant. The effects on mood would be explored indirectly through responses to questions regarding altruistic behaviour.

Study 2

The Music

The researchers selected a range of music which they believed would be perceived as pleasant and calming or unpleasant, arousing and aggressive. These pieces were played to a group of ten children of the same age range as the participants, who were asked to rate them on a five-point scale on a number of dimensions: calm/exciting; pleasant/unpleasant; happy/sad; lively/sleepy; relaxed/tense; and gentle/aggressive. The criterion for the inclusion of the music in the study was that the majority of pupils should have attributed the same extreme characteristics to the pieces of music. On the basis of this process, the two pieces of music selected to be used in the study were: Albinoni's Adagio in G minor (pleasant, calming music) and from Meditations by John Coltrane 'The Father, the Son and the Holy Ghost' (unpleasant, aggressive).

The Pupils

Thirty children from three Greek schools in England were selected to take part. They were randomly allocated to three groups: a control group; a group listening to quiet, calming music; and a group listening to exciting, aggressive

music. There were 15 boys and 15 girls, five in each group. All the children were in year 6, age 11–12.

The Tasks

The memory task. The task was a moderately difficult one, requiring the pupils to remember a word from a sentence. Recall was cued by the remainder of the sentence being presented. Each student was provided with a booklet of ten stimulus sentence cards and a booklet of ten cued recall cards. The ten sentences were selected from those used in a study by Pressley *et al.* (1987). The sentences contained arbitrary relations in which particular men performed actions. The target words were the adjectives which described the men, e.g. 'The *ugly* man bought some plastic.'

The booklet with the cued-recall cards consisted of the same sentences presented, one on each page with a gap in place of the target word, e.g. 'The … man bought some plastic.' Each participant was presented with a booklet containing ten stories and a choice of response to them.

The task to assess the level of altruism. Children were presented with a series of stories which were devised to include a balanced gender mix to which they were given a choice of response. Two examples are given below:

> *Example 1:* Tom and Nick are classmates. Tom is good at maths while Nick is weak. Their teacher told them that everyone who finishes their maths' exercises can go out to play. Tom has almost finished his exercises when Nick asks him for help. What do you think Tom is going to do?'
>
> A. Tom will stay and help Nick
>
> B. Tom will tell Nick that he does not know the answers so that he can to out to play
>
> *Example 2:* Peter and Angela are going to the cinema to watch a film and they are in a hurry because they are late. At the traffic lights a blind woman is standing next to them and asks them if they can take her to the chemist, which is in the opposite direction to the cinema. What do you think they are going to do:
>
> A. They will refuse saying that they are in a hurry
>
> B. They are going to help her knowing that they will miss the first 10 minutes of the beginning of the film.

TABLE IV. Performance on the memory task

	Control (no music)		Unpleasant agressive music		Pleasant, calming music	
	Mean	SD	Mean	SD	Mean	SD
Whole sample	4.9	1.37	3.3	1.49	6.9	1.52
Boys	5	1.87	3.2	1.9	7.2	1.3
Girls	4.8	0.84	3.4	1.14	6.6	1.8

Procedure

The children were divided into three groups on a random basis. They were instructed as follows:

> The purpose of this study is to find out how well you can learn sentences. Please read the following sentences and try to memorise them. You will have 10 seconds to read each sentence. Every ten seconds I will tell you to turn the page to the next sentence. Do you all understand? Are there any questions?

Every ten seconds the children were asked to turn to the next page. When the sentences had been read, the booklets were collected and the cued-recall booklets given out. The children were then instructed:

> You have to fill in the gaps with the missing word in every sentence. Spelling mistakes do not matter. You will have 10 seconds to write the missing word in each sentence. Every ten seconds I will tell you to turn the page. Do you understand? Are there any questions?'

There were no questions from the children at any point in the study. Where the background music was used, it was played during the whole procedure. Each piece was repeated until the completion of the study.

In the second phase of the study, the children were given the booklet with the stories. They were told:

> Please read the stories in the booklet and tick the answers that describe what the individuals in the story will do in the situation they are in. If you need more explanation please raise your hand.

Results

The means and standard deviations for each group are given in Table IV. An analysis of variance revealed highly significant differences between the three groups ($F = 15.17$, $df = 2,27$, $p = 0.0001$). There were no significant differences

TABLE V. Performance on the altruistic task

	Control (no music)		Unpleasant agressive music		Pleasant, calming music	
	Mean	SD	Mean	SD	Mean	SD
Whole sample	6.4	2.08	4.2	1.39	7.6	1.57
Boys	5.6	1.5	3.4	1.1	6.8	1.64
Girls	7.2	1.6	5	1.22	8.4	1.1

in the performance of boys and girls or significant interactions between gender and music conditions.

The means and standard deviations for the three groups on the altruistic task are given in Table V. An analysis of variance revealed that the differences between the groups were highly significant ($F = 12.09$, $df = 2,27$, $p = 0.0002$). There were also significant gender differences ($F = 9.76$, $df = 2,27$, $p = 0.005$). The boys consistently indicated less helpful responses than the girls. There were no significant interactions between the effects of the different kinds of music on boys or girls.

Discussion

The studies described above demonstrate that, where the type of background music played can be clearly defined by a group of listeners as calming and pleasant or arousing and unpleasant, it can have distinctive effects on task performance and the reporting of intended altruistic behaviour. Calming relaxing music had a positive effect on the number of mathematics problems completed, remembering words from sentences and on reported pro-social behaviour in children aged 10–12 years. Music perceived as arousing, unpleasant and aggressive had a negative affect on performance on a memory task and also led to a lower level of reported pro-social behaviour.

The findings suggest that the effects of music on task performance are mediated through its effects on arousal and mood. However, the research reported here provides only a very small contribution to our understanding of the ways that music might affect behaviour and various forms of studying. Much more systematic work needs to be undertaken which takes account of the characteristics of the individual, the nature of the music being played, the listening environment; recent life events of the individual, metacognition, and task requirements. Hallam *et al.* (submitted) has outlined a model which provides a framework for this. While in this instance, the music appears to have provided an optimal level of arousal for the tasks to be completed, in other cases, particularly where children have great difficulties with concentration, it may provide a non-verbal distraction which is less absorbing than other possible

distracters. If concentration is lost, attention becomes focused on the background music rather than in developing behaviour which completely disrupts work and disturbs others. The student briefly listens to the music and then returns to concentration on the task itself. This hypothesis requires further study.

The findings also show that some music can disrupt concentration and generate moods which may lead to less altruistic states of mind. This is important for research because it means that in considering the effects of music, account must be taken of the kind of music that is being played. It has proved difficult in the past to describe systematically the ways that music differs in relation to mood and arousal. The method adopted here which relies on listeners' perceptions may prove valuable as a means of categorisation for future research.

The impact of the calming, relaxing music on task performance suggests that in schools, appropriately selected music could be used to create an optimum environment for children to undertake individual work. However, this should be approached cautiously. Currently, we do not know whether the calming effects of the music would habituate and lose their power if they were used regularly, although Savan (1999) has reported consistent effects on children with learning, emotional and behavioural difficulties over a long period of time. As a first step, teachers might explore using music at times when children are extremely over-aroused rather than on a regular basis, for instance, after lunch or break times when there are severe weather conditions or when children are excited about particular events, e.g. holidays, Christmas. Lively music could also be used to increase arousal, for instance if children are exhibiting signs of sleepiness.

Outside the classroom, music can also be used to promote desired behaviour, for example, a march to move pupils effectively round the school, quiet reflective music while waiting for assembly to begin, pleasant, relaxing music while meals are served. While some may feel that this undermines the value of music for its own sake, there is evidence that much of what we learn is acquired without our conscious awareness (Berns *et al.*, 1997). Music is no exception to this. Much of our knowledge of musical repertoire comes from listening in informal settings while we undertake other activities. The music selected for use in school to improve learning and behaviour could also enhance musical knowledge and thinking (Hallam, 2001b).

The findings may have even greater importance for the child's life outside school. Parents need to be aware of the effects that music can have on behaviour, particularly where they might be negative. Where the home environment is pervaded by highly arousing music, the child is likely to be more active. If the music is, in addition, perceived as aggressive or unpleasant it may lead to behaviour which is characterised as being antisocial. While older children and adults are able to recognise the negative impact of certain types of music on their behaviour and task performance, there is evidence that children of primary school age cannot (Hallam *et al.*, submitted). Parents therefore need to be

proactive in monitoring the music to which their young children are exposed and also teaching them about the possible effects of music, so that they can make appropriate choices of music when older for playing while undertaking homework and private study, which will enhance rather than disrupt their work.

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