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Can Music Move People ? The Effects of Musical Complexity and Silence on Waiting Time

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Abstract

Previous research has suggested that music might influence the amount of time for which people are prepared to wait in a given environment. In an attempt to investigate the mechanisms underlying such effects, the present study employed three levels of musical complexity and also a no music condition. While one of these played in the background, participants were left to wait in a laboratory for the supposed start of an experiment. The results indicated that participants waited for the least amount of time during the no music condition' and that there were no differences between the three music conditions. Other evidence indicated that this may be attributable to the music distracting participants' attention from an internal timing mechanism. The results are discussed in terms of their implications for consumer behaviour and research on the psychology of everyday life.

Can Music Move People ? The Effects of Musical Complexity and Silence on Waiting Time

In recent years there has been growing interest in the relationship between music and the listening environment (see e.g. Konecni, 1982; North and Hargreaves, 1997a). As we approach the end of the 20th century, one particular feature of many people's music listening is that it has become the backdrop to everyday life. While people still do often sit down and listen deliberately to music, there are an increasing number of occasions on which they listen in the course of some other activity such as driving, shopping, eating, or doing the housework. This has important implications, since it suggests that if we are to understand people's everyday lifestyles more fully, it becomes important to recognise that we must also understand the role of music in these. In short, we need to construct an account of the relationship between music and the listening situation, and the present study addresses one particular aspect of this.

To date, this relationship has been investigated by several diverse studies. These have concerned aggressive behaviour (see Konecni, 1982); delinquency (e.g. Bleich, Zillmann, and Weaver, 1991); physical attractiveness (Zillmann and Bhatia, 1989); helpfulness (Fried and Berkowitz, 1979); pain management (Standley, 1995); economic recession (Zullow, 1991); suicide (Stack and Gundlach, 1992); consumer behaviour (North and Hargreaves, 1997b); and warfare (Simonton, 1987). A better understanding of the relationship between music and the listening environment should therefore also be of interest to those concerned with the several aspects of the social psychology of everyday life.

One particular approach to this relationship has concerned the effects of music on subjective time perception and actual waiting time (see review by North and Hargreaves, 1997b). A few studies have indicated that music can influence the amount of time actually spent in a particular environment, and this finding has some obvious commercial implications regarding the use of music in stores or while people wait on-hold for their telephone call to be answered. For example, Ramos (1993) found that manipulating the musical style played to on-hold callers to a telephone advisory service influenced the number that hung up before their call was answered. Similarly, Stratton (1992) asked participants who were supposedly waiting 10 minutes for the start of an experiment to do so alone or in groups whose members either did or did not talk to one another. Non-talking groups who waited to musical accompaniment found the period less stressful than non-talking groups without music. Although perceived time was not the focus of the study, the non-talking groups without music gave significantly higher retrospective time duration estimates (M = 16.33 minutes) than did other groups, including the group who talked while waiting without music (M values ranging from 9.36 to 11.76 minutes). Note also that the time duration estimations given by the former group were less accurate than those given by the others, although the rather low N sizes suggest that such findings should be treated with a degree of caution particularly since SD values are not reported. Finally, Yalch and Spangenberg (1990) found that what they termed 'background music' led to under 25 year old clothes shoppers reporting having spent more unplanned time in-store, whereas older participants showed the same effect when louder, 'foreground music' was played. While results such as these are interesting, one potential direction for further research is to determine precisely which characteristics of music cause it to mediate waiting time.

One possible explanation for these results is that waiting time should increase in the presence of liked music and decrease in the presence of disliked music. A considerable amount of research has supported Berlyne's (1971) theory that liking for musical pieces can be predicted by their complexity: pieces of moderate complexity are generally preferred to those of either low or high complexity, giving rise to a so-called inverted-U relationship between liking and complexity (see reviews by Hargreaves, 1986; Finnas, 1989; North and Hargreaves, 1997a). This is because pieces of moderate complexity elicit maximum arousal in pleasure centres of the brain, but without bringing about arousal in displeasure centres (see Berlyne, 1971): in contrast, pieces of low complexity music bring about little activity in either the pleasure or displeasure centres; and pieces of high complexity bring about high levels of activity in displeasure centres which override activity in pleasure centres.

An earlier study (North and Hargreaves, 1996) found that moderate complexity pop music led to the greatest number of people visiting the environmental source of that music, namely a student welfare advice stall set up in a university cafeteria: high and low complexity music and also no music led to fewer visitors. In light of this, it is possible that waiting time should also be increased by music of moderate complexity.

However, it is also possible to formulate an alternative hypothesis. Several studies of time perception have indicated that subjective time (i.e. our own personal experience of time) is governed by an "internal clock". At the risk of over-generalising, research indicates that this internal clock can be biased, such that distractions from it caused by environmental stimuli can influence the perception of how much time has elapsed (see e.g. Fraisse, 1984; Kellaris and Mantel, 1994; Kellaris and Mantel, in press; Zakay, 1989). For example, Zakay (1989) suggests that participants who allocate more attention to processing stimulus events will be able to devote less capacity to their internal clock, such that their estimates of elapsed time will be become less accurate. In effect, as a participant becomes more involved in a processing task, less attention should be paid to the passage of time. This might have implications regarding the relative effects of music and silence on waiting time: the presence of music in the environment might cause a participant to pay less attention to his/her internal clock than in a music-free but otherwise identical environment. In effect, time estimations should be less accurate in the presence than in the absence of music.

Given this, what might be the relative effects of music and silence on waiting time ? The answer to this depends on the direction of inaccuracy in subjective time caused by music. For example, if music causes a general under-estimation of subjective waiting time, then it should also lead to an increase in actual waiting time: in this case, music means that the participant does not think that he/she has been waiting very long and so he/she should actually wait longer than someone who did not hear music. It may also be possible to make a tentative a priori prediction concerning the direction of the effect on waiting time that music might have relative to silence. This prediction is based on a small number of studies carried out by Kellaris concerning the effect of differing musical properties on retrospective time estimations (Kellaris and Altsech, 1992; Kellaris and Kent, 1992; Kellaris and Mantel, 1994; Kellaris, Mantel, and Altsech, in press).

Kellaris drew on research on time perception in arguing that retrospective estimates of subjective time should increase with the amount of musical information that the listener encodes (see e.g. Ornstein, 1969). Put simply, the perceiver employs the heuristic that it takes longer for more things to happen. Perhaps not all authors would agree entirely with Kellaris' analysis (see e.g. Fraisse, 1984; Hogan, 1978), but if he is correct then we might predict tentatively that music could lead to specifically longer retrospective time estimations than no music: more information should be encoded by participants in the presence of music than in its absence, thus increasing subjective time estimates in the former case. In turn, this should lead to participants actually waiting for less time in the presence of music: participants who are exposed to music should perceive themselves as waiting for longer than do participants who are not exposed to music, and so the former group should also actually wait for less time.

The present study investigated the relative effects of low, moderate, and high complexity pop music, and also no music on the amount of time for which participants were prepared to wait for the supposed start of an experiment. Participants were shown into a laboratory, and then left alone while the experimenter went supposedly to find an important piece of equipment. As they waited, the participants listened to music of one of three complexity levels or no music, and the experimenter timed how many minutes elapsed before the participant left the laboratory. Two alternative hypotheses can be formulated on the basis of the foregoing literature review, and the present study tests these against one another. First, if actual waiting time is increased by liked music, then participants should wait longest in the presence of music of moderate complexity, and no other differences should obtain between music of low and high complexity and also no music.

Second though, if actual waiting time is influenced by the effects of music on the accuracy of subjective time perception, then we might expect that silence should lead to different actual waiting times as compared with those elicited by any of the three types of music. The effect of music in either specifically increasing or decreasing actual waiting times relative to silence should depend on whether it causes participants to respectively under- or over-estimate waiting time. Given Kellaris' arguments there are some preliminary grounds for predicting that music might lead to specifically the over-estimation of waiting time, and consequently shorter actual waiting times than might silence.

Method

Participants One hundred psychology undergraduates volunteered for an "easy 5 minute experiment on timing songs by The Beatles" as part of their course requirement The sample comprised 38 males and 62 females with a mean age of 18.72 years (SD = 1.11).

Materials and Design The experiment employed an independent subjects design in which participants waited in the presence of low complexity pop music, moderate complexity pop music, high complexity pop music or no music. Twenty-five participants were assigned to each condition, with each participant being tested individually. The three music conditions each employed 5 x 4 minute non-vocal excerpts of commercially released new age/ambient music (see Appendix 1). This is a genre of modern pop music which was currently fashionable among young people, and has the advantage of varying widely in musical complexity. Within each condition, the excerpts were recorded from CD onto cassette such that the 5 excerpts were on a continual loop. Two excerpt orderings were employed.

The complexity levels of the experimental excerpts had already been determined in an earlier study (North and Hargreaves, 1995). However, as an additional check on the complexity manipulation, the 15 musical excerpts were presented to a panel of three independent judges who were asked to sort them into low, moderate, and high complexity groups. Their judgements corresponded precisely with the proposed manipulation, although as one further check, participants in the experiment proper were also asked to rate the complexity of the music (see below).

A brief questionnaire was administered to each participant at the end of the experimental session. First, participants were asked to estimate retrospectively to the nearest minute the length of time they had waited. After this, participants responded to six questions by assigning ratings on scales from O to 10 on which O represented the minimum and 10 represented the maximum. The six questions were; (1) “To what extent were you tempted to leave the experiment before I returned ?”; (2) “To what extent did you enjoy waiting for me to return ?”; (3) “How irritated were you by being kept waiting ?”; (4) “If possible, then how willing would you be to volunteer again for this experiment ?”, (5) “How much did you like the music that was playing while you waited ?”; and finally, (6) “How complex was the music that was playing while you waited ? By complex, I mean the extent to which the music was unpredictable, erratic, and varied ?" (see Berlyne, 1971). Participants were then asked to rate the degree of attention they paid to the music on a scale from O ('none') to 10 ('complete attention'): all participants assigned ratings of 5 or greater. Finally, participants were asked if they had heard any of the experimental excerpts previously: none had, although their responses would have been discarded if they had prior experience of the music since this might influence its arousal-evoking potential (see Berlyne, 1971).

Procedure Having volunteered for an experiment on timing songs by The Beatles, participants were met by the experimenter in the foyer of the building where testing took place. Following a memorised script throughout, the experimenter asked the participant to follow and walked briskly upstairs to the laboratory, explaining that an important piece of equipment had to be obtained from another room before the session could begin With the obvious exception of the no music condition, the experimental music was playing when the participant entered the laboratory. The laboratory itself was empty with the exception of a tape deck, a stool for the participant, an empty filing cabinet, and a clipboard. The latter held a response sheet which was headed 'Timing Beatles' songs', and went on to state 'Duration of piece 1 = ... Duration of piece 2 = ' etc. The experimenter took the participant's watch, placed it in an envelope and put this in a filing cabinet drawer, explaining that the experiment would be about timing the duration of songs by The Beatles.

The experimenter then left the laboratory under the pretence of going to another room to obtain an important piece of equipment that was required before the experiment could begin. The participant was asked to listen to the music playing, and to stop the tape when he/she started to hear music by The Beatles. The experimenter explained that, on returning, the experiment could then begin immediately. Finally, it was stressed that 'for ethical reasons', the participant was free to leave at any time before the experimenter returned and would not incur any penalty for so doing. On leaving, the experimenter closed the door and started a stopwatch to measure the time elapsed before the participant left also. Once the participant had left, or once 20 minutes had elapsed, the experimenter administered the questionnaire. Although the majority of participants who left the laboratory before 20 minutes had elapsed still had their watch in its envelope, four participants had already taken it out before being approached by the experimenter with a view to completing the questionnaire. Consequently, these four participants' data were discarded and replacements were recruited. Interviews with participants at the end of the study confirmed that the proposed deception had been effective, with several for example asking why there did not seem to be any Beatles' songs on the experimental tapes. Participants were de-briefed fully once all 100 had been tested, and were given the opportunity to destroy their data.

Results and Discussion

A χ^2 test was carried out to investigate any possible association between the type of music (or no music) played and whether participants left the laboratory before the experimenter returned after 20 minutes. The result of this was significant (χ^2 (3) = 11.91, $p < 0.01$). Twelve participants left the laboratory before 20 minutes had elapsed in the no music condition, and the corresponding figures for the low, moderate, and high complexity music conditions were 4, 3, and 4 respectively. Given that the number of participants actually leaving was rather low (albeit statistically significant), a one-way independent subjects ANOVA and Tukey tests were carried out to investigate the effects of the different conditions on measures of participants' actual waiting times. The ANOVA result was significant (F (3, 96) = 4.48, $p < 0.01$) with the Tukey tests indicating that participants waited for significantly less time in the no music condition (M = 15.32 minutes), than in the low complexity (M = 19.30 minutes), moderate complexity (M = 18.80 minutes), or high complexity (M = 18.48 minutes) conditions. There were no other differences between the conditions.

A series of one-way ANOVAs and Tukey HSD tests was carried out to investigate any effects of music/no music on the questionnaire measures of responses to being kept waiting (and also ratings of the complexity of the music played). The results of these are reported in Table 1. The results for ratings of musical complexity confirm that those pieces labelled as low, moderate, and high complexity respectively were perceived as such by the participants, and as such verify the proposed manipulation of this factor.

- Table 1 about here -

In conjunction, these results demonstrated that participants were more likely to leave the experiment before the experimenter returned when no music was played than when any of the three types of music were played. Analysis of actual waiting times indicated a similar pattern, with shorter waiting times in the silence condition than in any of the music conditions, and no significant differences between any of the music conditions. The same pattern was shown again in participants' responses to the questionnaire, with participants in the no music condition reporting being more tempted to leave early than participants in any of the music conditions. In short, the presence of music caused people to wait longer, and the specific type of music played seemed to have no additional effect on this.

The only effect of musical complexity per se was on questionnaire ratings of enjoyment of the waiting period. High complexity music led to lower enjoyment than did music of either low or moderate complexity. This effect is particularly interesting in light of the finding that different levels of musical complexity did not influence participants' actual waiting time. More simply, lower enjoyment in the high complexity condition did not translate into an increased propensity to leave the experimental session.

To further investigate the roles of music and silence on waiting time, a new variable, ESTACT, was calculated for each participant as the product of estimated waiting time minus actual waiting time. A negative value of ESTACT indicates that the participant under-estimated the amount of time they actually spent in the laboratory, and values close to zero indicate that the participants' time estimation was accurate. A one-way independent subjects ANCOVA was then carried out to test for differences between the conditions in ESTACT, controlling for variations in actual waiting time. The result of this was significant (F (3, 95) = 2.77, p = 0.05), with mean values of ESTACT all demonstrating under-estimations of time duration as follows; low complexity = -5.20 minutes, moderate complexity = -5.10 minutes, high complexity = -7.88 minutes, and no music = -3.80 minutes.

The results of this ANCOVA indicate that actual waiting time was under-estimated in all four conditions. However, time estimates obtained from the no music group were more accurate than those obtained from the three music groups even when it is taken into account that the former actually waited for less time. However, the differences in subjective time estimates across the present conditions might explain why no music led to shorter actual waiting times than did any of the three types of music. Put simply, if participants in the no music condition thought that they had been waiting for longer than did participants in the music conditions, they might indeed be more likely to leave the laboratory before the experimenter returned.

Such an effect is consistent with the notion of music causing disruption to an internal clock which governs participants' time perception. Participants who were not exposed to music would not have experienced this disruption, and this might explain why they were less prone to under-estimate the amount of time for which they waited and in turn be more prone to leave the laboratory earlier. In further support of the notion that music disrupted participants' internal clock, it is perhaps worth noting that the greatest under-estimation of elapsed time occurred in the high complexity music condition. Since high complexity music by definition contained the most information, it might have been expected to cause the greatest degree of disruption to an internal timing mechanism: in short, it would be expected to present participants with more of a distraction from their internal clock than would the other conditions.

However, the relative direction of the effects of music and no music on actual waiting time are inconsistent with Kellaris' preliminary studies. As noted above, although some might disagree (e.g. Hogan, 1978), we could infer on the basis of these studies that listening to music should lead to specifically longer subjective time estimations than no music because music increases the amount of information which participants are required to process. This increase in subjective time should in turn have meant that music led to shorter actual waiting times than did no music, and it is obviously disappointing that the present results did not correspond with this more tentative prediction. However, the discrepancy between the findings and those we might have predicted on the basis of Kellaris' work concerns only the direction of influence that music might have rather than the more fundamental mechanisms by which it might affect temporal cognitions and related behaviours. In short, the results are consistent with Kellaris' suggestion that music should have disrupted participants' internal timing processes, but are inconsistent with the inference drawn from Kellaris' work that music should have led to specifically longer subjective time estimations and therefore specifically shorter actual waiting times than no music.

A second, perhaps related, explanation for the detrimental effects of silence on waiting time is provided by three product-moment correlations carried out on responses obtained within the three music conditions. These correlations demonstrate that liking for the music was correlated negatively with reported irritation at being kept waiting ($r = -0.31$, $N = 75$, $p < 0.01$); and positively with reported enjoyment of the waiting period ($N = +0.49$, $N = 75$, $p < 0.001$); and also participants' actual waiting time ($r = +0.25$, $N = 75$, $p < 0.05$). One possible conclusion that might be drawn from these is that perhaps the mere opportunity to listen to music provided participants with something to do in an otherwise unstimulating environment. In short, the music may have provided some form of diversion that prevented participants from becoming so disenchanted with the environment that they actually left. This argument would constitute an obvious issue for future research, although it has clear parallels with Stratton's (1992) finding described above that under certain conditions, music might decrease the degree of stress associated with waiting. Perhaps music in some way makes people feel attended to, and more specifically, it would be interesting to determine whether the present results could be replicated in a more stimulating environment when the presence of music has more opportunity to be an actual irritant rather than a mere diversion. One example of such a situation might be a crowded bar, where the loud music makes it very difficult to hear what companions are saying. More generally, it might also be interesting to investigate prospective time estimates (as distinct from the retrospective measures employed here), since these may also yield a different pattern of results from that obtained here (see e.g. Fraisse, 1984)

It is also interesting to compare the present findings with those obtained by Stratton (1992). Although the focus of Stratton's study was on perceived stress while waiting rather than time perception and actual waiting time, she did note that no music led to the greatest degree of inaccuracy in time duration estimations (providing participants did not talk). This contrasts with the present results which indicate that no music led to the most accurate time duration estimations. However, the direction of the inaccuracy in Stratton's study was such that participants waiting in silence without music gave the longest mean time duration estimations: in this respect the present results do tally with Stratton's, and attempts to resolve these two findings may well have interesting theoretical implications.

Before concluding, it is worth noting two potential commercial implications of the present findings. First, if any music can cause people to spend more time in an unstimulating environment then it is perhaps good commercial practice to play music in shops and stores: the music might well be expected to cause people to linger and perhaps also spend more money (see e.g. Milliman, 1982; 1986). Second, despite the public ridicule to which it is often subjected, on-hold telephone music may be more effective than silence in persuading customers to stay on the line. These potential applications of the present findings await future field studies which would possess greater ecological validity than the present research.

In the meantime, this study has demonstrated that no music can lead to shorter actual waiting times than does music, and that this may be the result of music disrupting subjective time perception and/or providing a diversion in an otherwise unstimulating environment. Aside from the commercial implications of this, the present results indicate another way in which background music can influence responses to the listening environment. In short, results such as these illustrate that music does not exist in a 'vacuum': instead it interacts with the listening environment. Given the prevalence of music in a variety of everyday tasks and surroundings, these results suggest that any attempt to explain music listening behaviour must also account for its effects on responses to the context in which this occurs.

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Appendix 1- Experimental Stimuli

Aphex Twin - Tha; Acid Junkies - Figment of one's imagination; F.U.S.E. - Theycch; Biosphere - Cloudwalker; Neuro - Mama; Enigma - Callas went away; Tangerine Dream - Song of the whale; Adiemus - Adiemus; Sacred Spirit - Winter ceremony; Sade - Mermaid; Jon Hassell - Ravinia/Vancouver; Michael Waisvisz - The hands (Movement 1); Clarence Barlow - Relationships for melody instruments; Stephen Kaske - Transition nr. 2; James Dashow - Sequence symbols

	Mean for low complexity	Mean for moderate complexity	Mean for high complexity	Mean for no music
To what extent were you tempted to leave the experiment before I returned ?	4.16^{a}	3.52^{b}	4.16^{c}	7.32^{abc}
To what extent did you enjoy waiting for me to return ?	4.13^{a}	4.46^{b}	1.71^{ab}	2.76
How irritated were you by being kept waiting ?	4.44	4.16	5.06	5.20
If possible, then how willing would you be to volunteer again for this experiment ?	5.64	6.68	5.60	4.63
How much did you like the music that was playing while you waited ?	5.72^{a}	5.76^{b}	1.88^{ab}	N/A
How complex was the music that was playing while you waited ?	2.56^{ab}	4.88^{ac}	7.92^{bc}	N/A

$d.f. = 3, 96$ except for * where $d.f. = 2, 72$
Within each row, means marked by similar symbols differ at the $p < 0.05$ level

Table 1 - Summary of one-way ANOVAs to test for differences between the conditions on responses to the questionnaire