DURMS
Durham Undergraduate Research in Music & Science

The Effect of Music Genre on 400-Metre Sprint Performance

Isabella Elwes
Durham University

ABSTRACT

The present study tested the effect of musical genre on the speed of running 400-metres at maximal intensity. 12 participants from Durham University took part in the test: six men and six women, all of whom were between the ages of 18 and 21 and who regularly take part in sporting endeavours. They were asked to sprint 400-metres four times, with ten minutes of seated rest in between each run. For every sprint, they were given music to listen to via earphones: one pop song, one jazz song, one house song, and once with no music. The expected result was that listening to pop music would generate the fastest running times; however it turned out that listening to house music improved sprint pace most effectively, and no music had the least effect. This is perhaps due to the repetitive and relentless beat of house music, whilst no music may be ineffective because runners can hear themselves breathing and have nothing to distract them from how tired they feel.

1. INTRODUCTION

The relationship between music and sporting performance is a well-researched area of scholarship. A significant study in this field titled '*Influence of Music on Maximal Self-Paced Running Performance and Passive Post-Exercise Recovery Rate'* (Kimmerly & Lee 2014), investigated how fast tempo music affects running performance, and how slow tempo music affects the runner's recovery rates, post-exercise. The authors collected data on running speed, heart rate, ratings of perceived exertion during the exercise, and blood lactate concentrations and heart rate post-exercise. The study concluded that listening to fast music improves running speed with minimal perceived exertion. There are a few elements to consider here, both positive and negative. Firstly, the authors admit that their experiment would have been strengthened had they used combinations as opposed to single variables (e.g. listening to fast music during exercise, and then slow music during the recovery period). A significant strength of the study, however, was the use of noise as the control; this meant that, instead of having no music, they used noise with no tempo or rhythm, somewhat like white noise. Therefore, any results taken could be identified as a cause of listening to *music,* as opposed to listening to sound. I chose to use no music in this study however, as it is far more likely for people in real life to run to no music than to static noise. The aim was to make this experiment as close to reality as possible, to make the results more generalizable.

Comparing Kimmerly and Lee's experiment with the present study, the number of participants is the same (12), however, this study was more narrowly focused - testing only speed of running, as opposed to other variables, such as heart rate and ratings of perceived exertion; these additional variables might be a good extension of the present study in the future.

Another notable study titled '*The Effects of Synchronous Music on 400m Sprint Performance*' (Simpson & Karageorghis, 2006), tested the effects that motivational and oudeterous (neither motivating, nor demotivating), synchronous music has on 400-metre sprint running performance. Synchronous in this context means that the tempo of the music matches the pace of the activity (i.e. 400-metre sprint pace). 36 Caucasian males sprinted 400-metres three times - once listening to motivational music, once to oudeterous music, and once with a no-music control. These were predetermined music choices (32 in total), all rated for their motivation, using the Brunel Music Rating Inventory by 20 volunteering Caucasian males. Only one of Simpson and Karageorghis' two hypotheses was supported: synchronous music did improve performance compared to the no-music control; however, performance with motivational synchronous music was not better than that with oudeterous music, as they had initially expected. This research is similar to the present study, as the running distance is the same – 400-metres. However, it must be brought to note that their participants were exclusively male and Caucasian. While most of the participants in the present study were also Caucasian, there were an equal number of men and women to diversify the type of participants and yield a more representative set of results. By restricting the diversity of participants in their study, Simpson and Karageorghis' results were less representative.

Other related research in this field includes '*Effects of Music Interventions on Emotional States and Running Performance*' (Lane et al. 2011), '*Psychological Effects of Music and Music-Video During Treadmill Running*' (Hutchinson et al. 2014), and '*The Effects of Music Tempo and Loudness Level on Treadmill Exercise*' (Edworthy & Waring 2006). These each add various elements to the existing literature. For example, both the Hutchinson et al. and the Edworthy and Waring experiments bring forth the idea of running on a treadmill, in contrast to the outside track that was used in the present study and many others. This primarily eliminates the possibility of weather being an affecting factor. In addition, the Lane et al. experiment promotes the idea that motivational music affects emotions and thus subsequently the sporting performance of the participants. While these studies are valuable pieces of research in an ever-expanding field of scholarship, there appears to be a paucity of scholarly information with regards to how the *genre* of music directly

affects sporting performance. Therefore, this was the focus of the current study, specifically how genre affects sprint performance.

The chosen hypotheses were that 'listening to no music would result in the slowest running time' and 'listening to pop music would result in the fastest running time' compared to jazz and house music. This was decided because pop music generally has an established pulse and rhythm - a feature that is known for decreasing runners' ratings of perceived exertion (Szmedra & Bacharach 1998). The same applies to house music, yet, as pop music generally is more well-known than house music, it was thought that the runner might be more engaged and would therefore run faster to pop. Furthermore, pop music tends to have more lyrics than house music; listening to these lyrics might provoke an emotional connection to the song that may further increase the runners' speed.

2. METHOD

Participants. This study comprised 12 participants (female = 6, Mean age = 20, SD = 0.60). They were all students from Durham University who regularly took part in sporting endeavours (Mean hours per week = 7.29).

Design. The 12 participants were split into three groups of four. Each person in groups A, B and C listened to the songs in the same order as the equivalent runner from each of the other groups (e.g., the first runner from each group listened to jazz first, then pop, then house, then no music). The order of music (and silence) conditions was counterbalanced, such that an equal number of people completed each ordering. This ordering method also allowed for comparison between people running with the same order of music (this is laid out clearly in Figure 3).

Procedure. The testing took place on Friday 23rd February 2018, at Maiden Castle sports ground in Durham. The participants ran on a 400-metre outdoor track, and they completed their seated rest on plastic spectator seats, near to the track. Please see Appendix 1 for the schedule. Once the participants had arrived and had filled out the consent forms and questionnaires, they were invited to warm up as they saw fit, which generally meant jogging around the track and stretching. The liberty was taken for participants to warm themselves up due to them all being sportsmen and sportswomen. Two armbands were distributed: one to the first runner and one to the next runner, into which an iPhone would be inserted (the same device was always used to play the music for the sake of experimental consistency). These armbands were passed from the runner to the runner second in line, as each one finished their sprint. The music was played at a constant volume through the phone for all participants. Each participant provided their own headphones for hygiene reasons, however everyone brought Apple earphones to keep this variable constant. An assistant helped during testing, who oversaw starting off the runners and timing their laps with a stopwatch. A countdown of five seconds was administered before they were to begin, during which time the music was started on the phone. As soon as they had finished their run, the phone was removed from the armband and inserted into the next runner's armband, simultaneously inputting their earphones into the phone jack. This was done at speed, as the time between the previous runner finishing and the next runner starting was generally only about two minutes. Once the phone was taken out of their armband, the runners were encouraged to sit and rest straight away, for approximately ten minutes until their next run. The reason for this being approximate was the variance in running times; however, their next starting time was always 11 minutes after the starting time of their previous run.

Stimuli. With regards to the stimuli used, after much deliberation, the selected genres were pop, jazz, house and no music. These were selected because it could be argued that they are the most popular genres of music to accompany running. No music was also included as a control condition, as many people run to no music. Whilst appreciating that these are broad genres, the songs chosen to represent each genre were:

Pop - *More Than a Memory*, Carly Rae Jepson
Jazz - *The Philosopher*, Ezra Collective
House - *BPM 127*, Soundage

Because genre was exclusively the independent variable, it was decided that all the songs should have the same beats per minute/tempo, to minimise confounding effects on the results. Therefore, the three songs all had a tempo of 127bpm. Furthermore, the pieces were chosen in the hope that none of the participants would know the songs. This is for many reasons, the most important of which is the fact that the lack of familiarity puts everyone in the same position. For instance, if person A was more familiar with a song than person B, person A might be more likely to run faster to it, singing along in their head. To achieve this, a pilot test was carried out, asking 12 people in the same age range, from the same university and who were not partaking in the experiment, whether they knew the songs. None of them did and, according to the post-experiment questionnaire, neither did the participants (See Appendix 4). Additionally, it was chosen for 'The Philosopher' to start at one minute, because the song takes a while to build up.

3. RESULTS

Whilst bearing in mind that the number of participants in this study is quite small, some interesting results arose, suggesting an idea as to the most effective music genre to listen to while running 400 metres (if in fact 'effective' means resulting in the fastest time, rather than anything relating to the runners' breathing or heart rate, for example). Please see Figure 1 for an outline of the running time results.

Figure 3 shows the mean percentage of the world record time achieved by the group of 12 athletes for each music genre

separately. This graph includes both men and women. The results are displayed as a percentage of the men's and women's world record, to effectively compare results across gender. The men's world record is 43.03 seconds and the women's world record is 47.60 seconds. To find said 'percentage', the following equations were used: '=(43.03/time)' for men and '=(47.60/time)' for women (Appendix 2 shows the interim step of working out percentages of world records and averages).

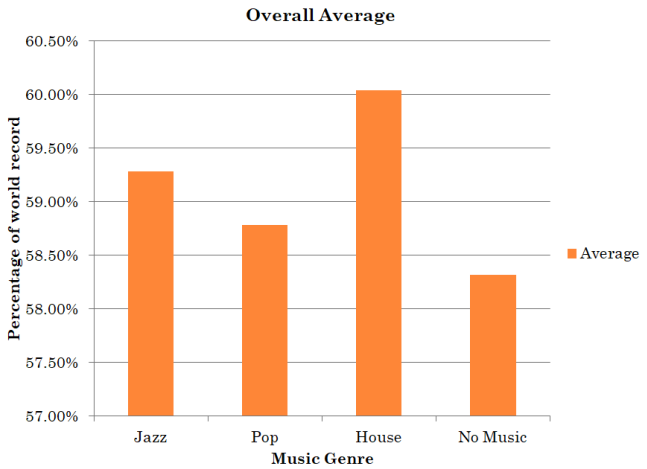


Figure 1: General results of the study.

The overall average time to run 400-metres was 69.68 seconds for men and 86.34 seconds for women and the average percentage of the world record was 62.31% for men and 55.95% for women. From this, one can deduce that the fastest genre of music to run to was house music, followed by jazz, followed by pop, followed by no music. Despite supporting the hypothesis that no music would result in the slowest running time, these results do not support the other hypothesis, which suggests that pop music is the best to run to. Of the music conditions, pop is seen to be the 'worst' music to run to, if speed is the main consideration. It was interesting to discover, however, that in the post-test questionnaire, when asked what their favourite music to run to was, 5 answered pop (41.67%), and when asked to rank their favourite to run to on the day, 4 answered pop as their best (36.36%), and 4 answered pop as their second best (36.36%). Please see the Supplementary File for a full account of preferences.

Looking at each genre in turn, here are the results of the runners:

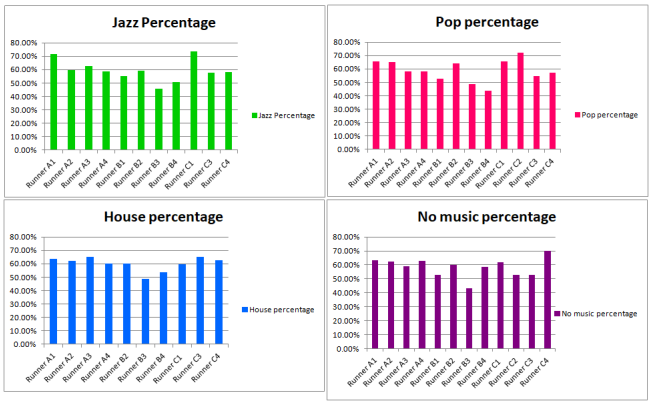


Figure 2: Results for each of the four genres

These graphs show how fast each participant ran to each genre of music, regardless of whether they listened to it on their first, second, third or fourth run. The direct comparison of each runner's times with different genres shows how everyone reacted differently and no genre was outstanding as being everyone's fastest. As was stated earlier, the first runner in each group listened to the music in the same order as the other first runners, and likewise for the second and the third and the fourth runners. Let us therefore investigate the shape of the graphs for each of these:

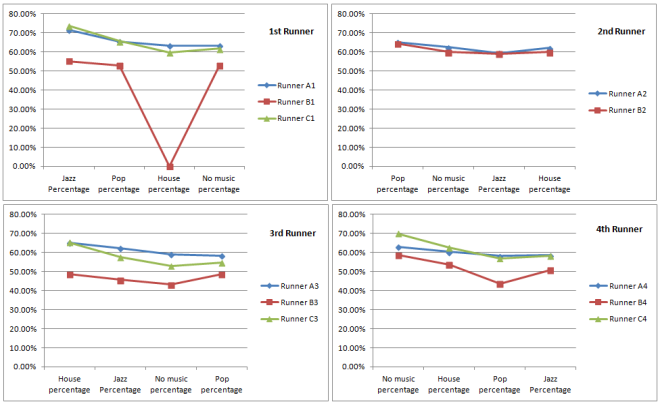


Figure 3: Results of the runners, grouped by their order of songs. The *x*-axis indicates genre conditions, whilst the *y*-axis indicates the mean percentage of the 400-metre world record time. Please note that there were some issues with Runner B1 and Runner C2's runs, to be discussed later, hence why these graphs are at times incomplete.

From these graphs, as is expected, each of the runners slow down over the four runs. However, most of the runners' last runs are quicker than their third run, perhaps because with the knowledge that it was their last run, they expended all their remaining energy. For every runner, their fastest run was their first run. This, and the shape of each graph, indicates that fatigue is an important factor to consider, as the results may well reflect tiredness more than the effect of the music. However, it is interesting that we can still seem to find the

overall effect of music genre, which is present above and beyond the fatigue effect.

4. DISCUSSION

The present study aimed to test the effect of music genre on 400-metre sprint performance. It was found that the hypothesis that running times would be slower with no music was supported. In addition, it was found that running whilst listening to house music resulted in faster average times for the run, followed by jazz music, and then pop. This study extends the findings of Simpson and Karageorghis (2006), for example, by adding the factor of genre to their study which was testing the effect of synchronous music on 400-metre sprint performance.

There were a few limitations in the current study. One includes the inevitability of human error whilst timing with a stopwatch. Times were recorded with an iPhone stopwatch, and because of the cold weather, the phone lost battery power and turned off when it was still at 18%. This occurred in the middle of Runner B1's third run, so it was decided to document it as 'NT' (no time), and we did not make the participant run it again.

Some of the men were not in optimal health, and Runner C2, was feeling unwell, and was thus unable to complete his final two runs. Therefore, whilst keeping him in some of the results, like the genre-specific graphs (Figure 2), his results were omitted from the more general graphs, like the overall average graph and the running-order-specific graph (Figures 1 and 3 respectively). Regrettably, this anomaly weakened this study by reducing the quantity of data available for analysis.

Another aspect in need of improvement was the use of Apple earphones. A lot of the participants had trouble running with these earphones as they often fell out, distracting them and thus slowing them down or decreasing the effect the music had on their running. A suggestion was that they should use Bluetooth headphones to eliminate the troublesome wires from getting in the way. Furthermore, the weather was always going to be a confounding variable. However, it got colder as the day went on, and the third group suffered tougher conditions than the first. This could have affected their running times as their muscles would have been tight and on the point of seizing in the cold; something that was only heightened by the fact that they had to rest sitting down. They proposed that there be walking instead and this would be a suitable amelioration, if the test was to be rerun. However, the repeated-measures nature of this experiment helps in this regard, since the participants are essentially each being compared to themselves in the four different tasks, rather than being compared to the other participants from earlier in the day.

The results from this small investigation are interesting. As mentioned earlier, one hypothesis - that listening to no music would produce the slowest running times - was supported; however, one hypothesis - that listening to pop music would produce the fastest running times - was not supported.

As there are no studies explicitly testing the effect of music genre on sporting performance, there are no direct comparisons with other studies to be made. However, the studies '*Effects of Music Interventions on Emotional States and Running Performance*' and '*Effect of Synchoronous music on 400-metre Sprint Performance*' - to name just a few - suggest that running to no music is less effective than running with music, and that idea is supported in the current study. The decision to use no music as the control, rather than a static noise, or a sustained note, for example, is notable. This decision was made because it is more likely for people to run in real life to no music than to a static noise, so 'no music' was included as a category in its own right as well as merely being a control. In conclusion, this study shows that everyone is different and runs fastest to varying genres; however, overall the genre of music that stimulates the fastest running times is house music, followed by jazz music, pop music and finally no music.

REFERENCES

Edworthy, Judy, and Hannah Waring. 2006. "The Effects of Music Tempo and Loudness Level on Treadmill Exercise". *Ergonomics*, 49/15: 1597-1610. doi:10.1080/00140130600899104.

Hutchinson, Jasmin C., Costas I. Karageorghis, and Leighton Jones. 2014. "See Hear: Psychological Effects of Music and Music-Video During Treadmill Running". *Annals of Behavioral Medicine*, 49/2: 199-211. doi:10.1007/s12160-014-9647-2.

Lane, Andrew M., Davis Paul A., and Devonport Tracey J. (2011). "Effects of Music Interventions on Emotional States and Running Performance". *The Journal of Sports Science and Medicine,* 10: 400–407.

Lee, Sam, and Kimmerly, Derek. 2014. "Influence of Music on Maximal Self-Paced Running Performance and Passive Post-Exercise Recovery Rate". *The Journal of Sports Medicine and Physical Fitness,* 56/1-2: 39-48.

Simpson, Stuart D., and Costas I. Karageorghis. 2006. "The Effects of Synchronous Music On 400-M Sprint Performance". *The Journal of Sports Sciences*, 24/10: 1095-1102. doi:10.1080/02640410500432789.

Szmedra, L, and D. Bacharach. 1998. "Effect of Music on Perceived Exertion, Plasma Lactate, Norepinephrine and Cardiovascular Hemodynamics During Treadmill Running". *International Journal of Sports Medicine,* 19/01: 32-37. doi:10.1055/s-2007-971876.

APPENDICES

Group A			Group B			Group C		
Time	Person	Result	Time	Person	Result	Time	Person	Result
12.00	J* Runner A1 1	1:00.22	15.00	J* Runner B1 1	1:26.18	16.00	J* Runner C1 1	58.44
12.03	P Runner A2 1	1:13.24	15.03	P Runner B2 1	1:06.92	16.03	P Runner C2 1	59.82
12.06	H Runner A3 1	1:13.32	15.06	H Runner B3 1	1:38.01	16.06	H Runner C3 1	1:06.42
12.09	N Runner A 4 1	1:15.73	15.09	N Runner B4 1	1:21.27	16.09	N Runner C4 1	1:01.56
12.11	P Runner A1 2	1:05.78	15.11	P Runner B1 2	1:30.20	16.11	P Runner C1 2	1:05.46
12.14	N Runner A2 2	1:16.27	15.14	N Runner B2 2	1:11.73	16.14	N Runner C2 2	1:21.18
12.17	J* Runner A3 2	1:16.30	15.17	J* Runner B3 2	1:44.23	16.17	J* Runner C3 2	1:14.73
12.20	H Runner A4 2	1:18.93	15.20	H Runner B4 2	1:28.50	16.20	H Runner C4 2	1:09.29
12.22	H Runner A1 3	1:07.89	15.22	H Runner B1 3	NT	16.22	H Runner C1 3	1:12.05
12.25	J* Runner A2 3	1:20.00	15.25	J* Runner B2 3	1:12.93	16.25	J* Runner C2 3	NT
12.28	N Runner A3 3	1:20.50	15.28	N Runner B3 3	1:50.49	16.28	N Runner C3 3	1:21.19
12.31	P Runner A4 3	1:21.88	15.31	P Runner B4 3	1:49.29	16.31	P Runner C4 3	1:15.48
12.33	N Runner A1 4	1:07.90	15.33	N Runner B1 4	1:30.19	16.33	N Runner C1 4	1:09.66
12.36	H Runner A2 4	1:16.67	15.36	H Runner B2 4	1:11.75	16.36	H Runner C2 4	NT
12.39	P Runner A3 4	1:21.59	15.39	P Runner B3 4	1:56.19	16.39	P Runner C3 4	1:18.76
12.41	J* Runner A4 4	1:21.35	15.41	J* Runner B4 4	1:33.73	16.41	J* Runner C4 4	1:13.82

KEY:
J = jazz
P = pop
H = house
N = no music

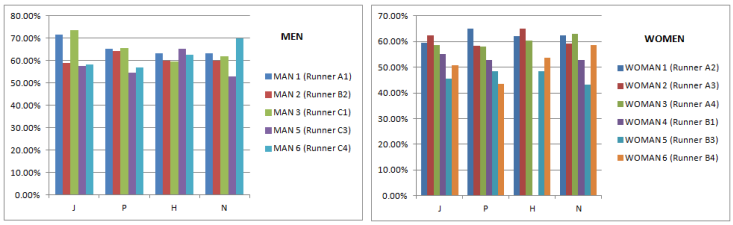
NT = no time
* = start music at 1 min

Please note the song order for each of the runners:
1st runner of group: J P H N
2nd runner of group: P N J H
3rd runner of group: H J N P
4th runner of group: N H P J

Appendix 1: Genre assignment and running times

Order of Running	Jazz Percentage	Pop percentage	House percentage	No music percentage
Runner A1	71.45%	65.42%	63.38%	63.37%
Runner A2	59.50%	64.99%	62.08%	62.41%
Runner A3	62.39%	58.34%	64.92%	59.13%
Runner A4	58.51%	58.13%	60.31%	62.85%
Runner B1	55.23%	52.77%	NT	52.78%
Runner B2	59.00%	64.30%	59.97%	59.99%
Runner B3	45.67%	48.57%	48.57%	43.08%
Runner B4	50.78%	43.55%	53.79%	58.57%
Runner C1	73.63%	65.73%	59.72%	61.77%
Runner C2	NT	71.93%	NT	53.01%
Runner C3	57.58%	54.63%	65.19%	53.00%
Runner C4	58.29%	57.01%	62.49%	69.90%
AVERAGE	59.28%	58.78%	60.04%	58.32%

Appendix 2: Results of the runners as a percentage of the men's and women's world records

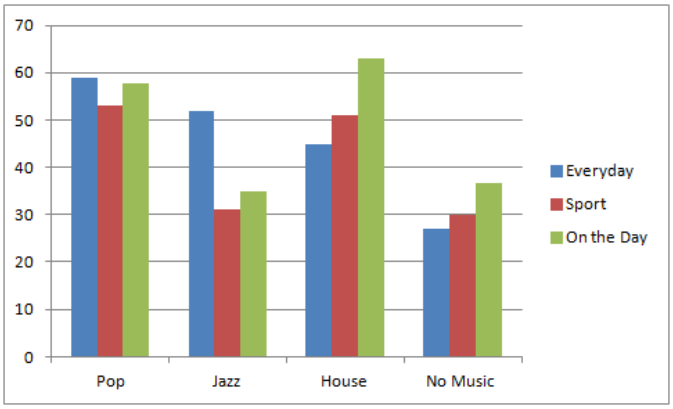


Appendix 3: Graphs showing the men's results and the women's results

Runner	Feedback
Runner A1	- N/A
Runner A2	Louder music horter headphone wire
Runner A3	Struggled to run with Apple headphones
Runner A4	- Really well run - Headphones got in the way slightly - Music volume varied slightly & was quite low
Runner B1	- N/A
Runner B2	- Louder music may have more of an effect
Runner B3	- Perfectly well run - Wish headphones had stayed in
Runner B4	- Use different headphones, e.g. overhead Bluetooth - Change seated rest to standing rest
Runner C1	- Difficult to control conditions with time of day, weather etc. - Difficult to control the state of us, hydration levels, food, sleep, niggles etc. - Sitting down was tough.
Runner C2	- N/A
Runner C3	- Music fell out quite a bit - Leave longer to recover
Runner C4	- N/A

Appendix 4: Table showing participant feedback

Appendix 5: Graphs comparing the participants' preferences for the music genres in an everyday situation; doing sport normally; during testing and their results.



Appendix 6: Graphs showing the overall preferences for the music genres in an everyday situation; doing sport normally and during testing