The Effect of Musical Genre during Post Treadmill Exercise Recovery Time

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ABSTRACT

Ergonomics focuses on human beings and their interaction with products, equipment, facilities, procedures, and environments that is used in work and everyday living. Ergonomics is applied in various areas of human life, such as manufacture industry, aerospace industry, transportation, education, health, etc. One of its applications is in sport industry, which is called sport ergonomic. Music as a part of working environment, is used to create a comfortable working environment, to reduce boredom and to disguise noise (Kroemer, et al, 2001). The previous reaserch showed that musical tempo significantly affected post treadmill exercise recovery time (Palit, 2015). The aim of this research is to understand the effect of musical genre during post treadmill exercise recovery time. The experiments are done at Ergonomics Laboratory of Petra Christian University. A three minutes treadmill exercise with a speed of 7 km/hour without any musical background is chosen as a physical activity. The recovery time is recorded during the recovering process while respondent listening to the music. Three levels of musical genre with slow tempo are chosen, they are new age, pop and rock. The desired response is faster heart rate recovery time. Randomize Complete Block Design is used as an experimental method. This study concludes that musical genre affects the post treadmill exercise recovery time, and new age genre has the fastest recovery time than pop or rock.

KEYWORDS

Musical genre; recovery time; treadmill exercise.

INTRODUCTION

Ergonomics focuses on human beings and their interaction with products, equipment, facilities, procedures, and environments that is used in work and everyday living (Sanders and McCormick, 1993). The objective of Ergonomics is to enhance the effectiveness and efficiency with which work and other activities are carried out and to enhance certain desirable human values. There are several focuses of Ergonomics, they are anthropometry, biomechanics, work physiology, human information processing, human computer interaction, display and control, working environment, and macro ergonomics (Iridiastadi and Yassierli, 2014). Ergonomics is applied in various areas of human life, such as manufacture industry, aerospace industry, transportation, education, health, etc. One of its applications is in sport industry, which is called sport ergonomic.

Nowadays, music as a part of physical work environment has an important role in human's life. Music is a collection of tones that are arranged to produce rhythm, song and harmony. Music is used to create a comfortable working environment, to reduce boredom and to disguise noise (Kroemer, et al, 2001). Music has several elements, they are sound, tone, rhythm, harmony, notation and genre. Musical genre is a musical grouping according to similarity of the musical technique, style, context and theme of the music. There are several musical genres, such as pop, rock, classic, new age, dangdut, jazz, and etc. According to Sills and Todd in 2015, the difference of musical genre influenced significantly on a person's heart rate. Average heart rate were significantly higher after listening to rock music, and heart rates also significantly decreased after listening to classical music. However, Orman (2011) stated that there was no significant difference in heart rate variability with high frequency measurement when participants listened to a musical selection from a genre they liked as compared with one from a genre they disliked.

Music has also an important effect in sport. Thakur and Yardi (2013) stated that both fast and slow music had a positive effect on treadmill exercise performance, which fast music increased the exercise duration more than slow music. Music also plays a role in post treadmill exercise recovery time. Manjunatha *et all.* (2014) and Bhavsar *et all.* (2014) stated that slow music had greater relaxation effect than fast or no music. Also, Palit (2015) concluded that musical tempo significantly affected the recovery time of post treadmill exercise. In this research, pop music was chosen with four level musical tempo (slow, medium, fast, and very fast). This study found that pop musical tempo significantly affected the post treadmill exercise recovery time, and slow tempo (66-76 bpm) had the fastest recovery time than the others. The preliminary studies still not investigate the effect

of musical genre on post treadmill exercise recovery time. Therefore, this research aims to understand the effect of various musical genre with slow tempo on recovery time of post treadmill exercise.

RESEARCH METHOD

Experiment is a series of test in which purposeful changes are made to the input variables of a process or system so that we may observe and identify the reasons for changes that may be observed in the output response (Montgomery, 2005). The objective of an experiment is to determine the influence of some factors (input factor or process factor) toward the output response of the system. The aim of this research is to know the effect of musical genre towards post treadmill exercise recovery time, and determine which musical genre which has best effect to the recovery time. Three levels of musical genre are used in this experiment, they are new age, pop and rock. The genre is determine based on the top three respondent preference genre. Each genre is represented by three song as seen in Table 1.

Table 1. Song list for each genre

Song	Genre	Tempo (in bpm)
I don't wanna miss a thing	Rock	61
Crazy	Rock	54
Cryin'	Rock	69
Make you feel my love	Pop	69
The Lion Sleeps Tonight	Pop	62
My everything	Pop	63
Hymn of the rising	New age	65
Breathe in Me	New age	52
Whisper to Me	New age	52

All songs are instrumental (without lyric) in order to avoid the effect of the lyric towards the relaxation time. Songs for each genre are played randomly and continuously. All songs have slow music tempo, around 40 – 69 bpm. Blocking is one of the experiment principles. Blocking is used to reduce or eliminate the variability of nuisance factor, factor that may influence the experimental response but not the main purpose of the experiment. Randomized Complete Block Design (RCBD) is one of the design techniques that is used to against nuisance factors. This method usually use when there is one factor and one nuisance factor. In this study, respondent is chosen as a nuisance factor and being blocked in order to minimize the effect of the respondent's variation.

The experiment is conducted at Ergonomic Laboratory, Petra Christian University. Conditions inside the laboratory are controlled in order to minimize the effect of extraneous factors. The recovery phase is conducted in a soundproof room with 24°C temperature. Respondents listen to the music from the same audio player with the same headset and volume level to avoid player variation. There are 21 male respondents. They are Petra Christian University's students which come from Economic, Communication and Letter Department, 20-21 years old with weight range 60-75 kg, and at least perform an exercise once per week. Each respondent encounters three treatments in the experiment according to the three musical genre levels. Each respondent only accepts one treatment per day, so each respondent completes all treatments in three days. Respondent must be in healthy condition, not in the fatigue condition, and neither hungry nor full, when they do the treatment. Totally there are 63 runs in this experiment. Randomization is conducted to determine the treatment's order that will be accepted by each respondent, but not determine the order of the respondent, according to the respondent schedule limitation.

The physical activity is a three minutes' treadmill exercise with a speed of 7 km/hour without any musical background. Heart rate monitor is used to collect the respondent heart rate data. The respondent's heart rate is measured in three phases, before treadmill exercise (initial phase), during the exercise, and after the exercise (recovery phase). Respondent is not allowed to do a verbal communication with others during the three phases and heart rate measurement for initial and recovery phase is done in the sitting position. During the exercise, respondent's heart rate is recorded every 30 seconds, so there are 6 times data collection during 3 minutes' treadmill exercise. At the recovery phase, respondent's listens the music using headset, and his heart rate is recorded every 30 seconds until back to his initial heart rate range. Initial heart rate range is obtained from minimum and maximum heart rate respondent's data of 2 minutes' heart rate data collection before treadmill exercise, which is recorded every 30 seconds as well.

The experimental data is analyzed by using ANOVA test to determine whether musical genre significantly affects the respondents' recovery time or not. Main effect analysis is used to determine which musical genre has best effect towards respondents' post treadmill exercise recovery time.

RESULT AND DISCUSSION

Respondents get one treatment per day. For each treatment, initial heart rate is taken before respondent do the exercise. After three minutes' treadmill exercise, respondent take a rest while listening to the music with certain

genre, according to randomization sequence that is done before. The recovery time is counted from the beginning of relaxing time until respondent's heart rate back to his initial heart rate range. The experiments are done by using Randomized Complete Block Design method. The experimental data can be seen in Table 2 and Figure 1.

Table 2. Respondent's heart rate data

Respondent	Musical genre	Initial heart rate range (bpm)	Exercise heart rate (bpm)						Recovery time (s)	Final relaxation heart rate (bpm)
			30s	60s	90s	120s	150s	180s		
1	*Pop*	70-75	122	135	145	144	146	149	270	75
	New age	68-75	117	138	144	146	150	151	180	75
	Rock	79-83	110	129	132	142	143	148	210	82
2	*Rock*	88-93	111	137	141	146	153	154	390	93
	Pop	81-88	118	122	138	144	145	148	210	87
	New age	84-90	116	130	138	142	147	151	240	90
3	*Pop*	88-94	137	160	166	175	184	187	360	94
	New age	90-96	126	148	158	164	178	181	450	96
	Rock	89-95	130	151	154	163	164	174	480	95
4	*New age*	72-78	111	128	137	140	144	146	210	78
	Pop	69-74	98	127	135	141	140	142	330	74
	Rock	77-82	94	117	132	152	151	156	390	81
5	*Pop*	78-83	109	112	150	152	143	149	240	83
	Rock	74-80	108	129	133	142	144	146	300	79
	New age	75-79	118	137	152	147	164	154	270	78
6	*New age*	82-89	134	143	157	162	165	171	270	86
	Rock	81-87	133	148	153	167	169	174	300	90
	Pop	81-88	133	140	147	158	168	171	630	88
7	*New age*	80-87	134	147	155	168	174	179	390	86
	Pop	79-86	138	143	149	159	166	173	480	86
	Rock	82-89	140	148	156	168	172	177	630	89
8	*Pop*	88-95	143	154	163	168	174	170	360	94
	Rock	86-89	141	149	158	166	170	176	360	95
	New age	84-88	137	145	157	164	165	170	300	95
9	*Pop*	72-80	105	112	118	124	127	133	330	80
	Rock	75-80	101	108	116	125	130	136	390	79
	New age	72-77	101	106	111	116	124	131	300	80
10	*Rock*	85-91	146	152	158	167	168	161	600	91
	New age	83-90	131	147	150	152	159	154	330	82
	Pop	86-91	150	158	167	157	160	168	450	91
11	*Pop*	97-102	165	172	177	188	186	190	600	102
	New age	91-97	160	174	175	177	175	180	570	96
	Rock	98-104	161	170	163	171	178	187	660	104
12	*Rock*	87-92	132	142	150	157	166	158	510	105
	Pop	80-86	126	137	147	152	159	165	330	84
	New age	82-85	108	111	121	136	145	142	420	75
13	*Pop*	89-95	165	173	177	178	180	179	570	95
	New age	87-91	150	155	172	170	175	175	480	91
	Rock	87-94	155	160	159	167	167	172	630	94
14	*New age*	64-69	87	114	123	127	134	135	150	66
	Pop	68-75	111	123	129	134	137	141	150	73
	Rock	65-73	119	126	129	143	138	142	180	73
15	*Pop*	107-112	158	167	174	207	205	175	360	111
	Rock	105-110	164	176	174	185	187	183	420	108
	New age	99-107	158	167	176	179	186	187	480	106
16	*New age*	84-88	133	144	155	162	170	172	630	88
	Rock	86-93	131	139	150	158	169	168	660	93
	Pop	82-88	125	141	147	158	170	171	510	88
17	*New age*	93-96	133	141	154	166	171	168	330	95
	Pop	95-101	127	144	145	157	166	165	270	101
	Rock	96-100	131	139	153	169	164	159	300	98

Table 2. Respondent's heart rate data (continued)

Respondent	Musical genre	Initial heart rate range (bpm)	Exercise heart rate (bpm)						Recovery time (s)	Final relaxation heart rate (bpm)
			30s	60s	90s	120s	150s	180s		
18	*Pop*	87-94	127	153	157	164	175	177	240	93
	Rock	85-93	106	117	126	137	152	164	270	92
	New age	84-91	109	124	148	151	153	168	150	94
19	*Pop*	77-83	129	150	159	163	168	171	390	81
	Rock	73-78	130	144	158	167	170	166	540	78
	New age	71-78	135	152	160	163	167	177	450	76
20	*Rock*	81-86	143	155	162	167	172	179	360	85
	New age	79-84	147	159	165	168	169	170	360	84
	Pop	83-89	144	158	170	173	173	175	300	89
21	*New age*	87-94	129	139	134	151	149	154	150	97
	Rock	87-93	124	129	134	146	151	152	150	91
	Pop	86-93	138	136	148	157	167	169	180	92

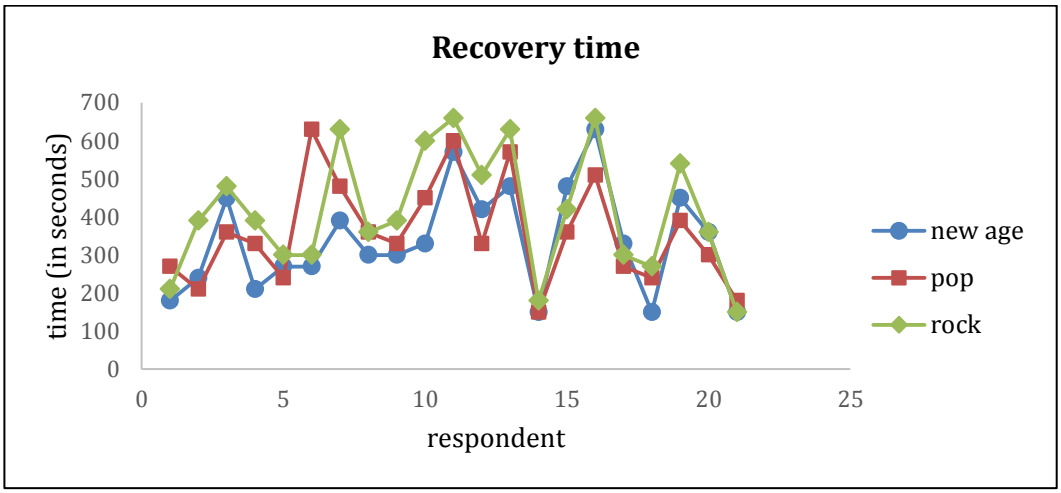

Figure 1. Recovery Time

From Figure 1, it can be seen that rock music makes the recovery time for each respondent is much longer than the others. ANOVA test is done to determine whether musical genre significantly affects respondents' recovery time or not. There is unusual observation for the respondent recovery time, it comes from respondent 6. Therefore, the recovery time data from respondent 6 are ignored and excluded, so there are only 60 recovery time data that are obtained from 20 respondents. The Minitab output for ANOVA test can be seen in Figure 2. The residuals are normally independent distributed, so the ANOVA test assumption is satisfied.

General Linear Model: recovery time versus respondent; genre

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Factor       Type   Levels  Values
respondent   fixed      20  1; 2; 3; 4; 5; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16;
17; 18; 19; 20; 21
genre        fixed       3  1; 2; 3


Analysis of Variance for recovery time, using Adjusted SS for Tests

Source       DF   Seq SS   Adj SS  Adj MS      F      P
genre         2    79770    79770   39885  12,82  0,000
respondent   19  1052400  1052400   55389  17,80  0,000
Error        38   118230   118230    3111
Total        59  1250400

S = 55,7792   R-Sq = 90,54%   R-Sq(adj) = 85,32%
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Figure 2. Anova test

The null hypothesis for this experiment is musical genre doesn't significantly affect post treadmill exercise recovery time; while the alternative hypothesis is musical genre significantly affect post treadmill exercise recovery time. *P*-value for the musical genre is 0.000. It means that musical genre significantly affects post treadmill exercise recovery time at 0.05 significant levels. Main effect analysis is done to determine which level of musical genre has the best effect to the recovery time. A lower time is desired and it indicates the fastest post treadmill exercise recovery time. The main effect plot for the recovery time can be seen in Figure 3. Figure 3 shows that faster recovery time is obtained when respondents have relaxing time with hearing new age genre and pop genre (compare to rock genre), and new age genre gives the fastest recovery time.

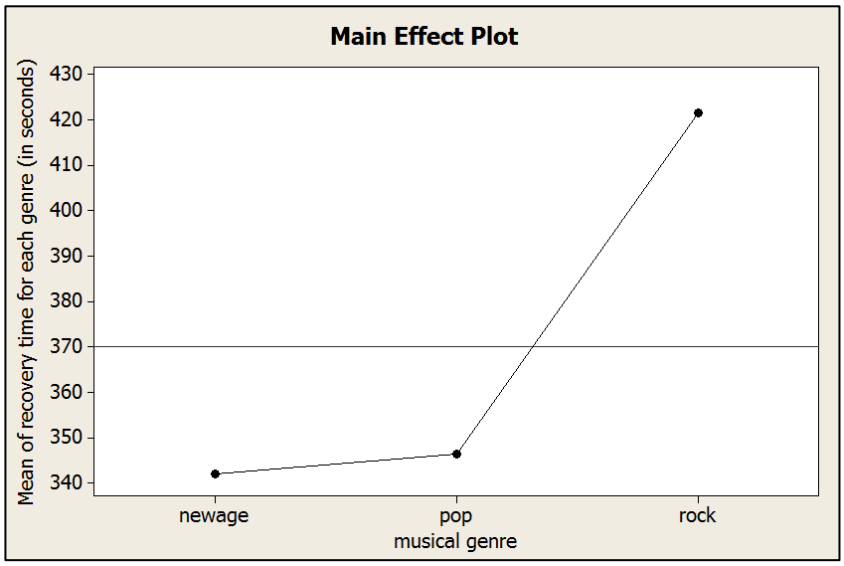

Figure 3. Main Effect Plot for Musical Genre

This result conform the previous study by Sills and Tod (2015) which concluded that various type of musical genre has a different effect on heart rate. New age music has soothing sound environments which give peaceful and calm effect, and it is often used in meditation. That is why, new age music also has a good effect in recovery time post treadmill exercises. This fact is also confirmed in Figure 4 which shows the average of respondent's heart rate during 3 minutes' treadmill exercise and the first 2.5 minutes of its recovery time. It is shown that since the first 2.5 minutes' recovery time, new age music already gives fastest recovery time compare to the others.

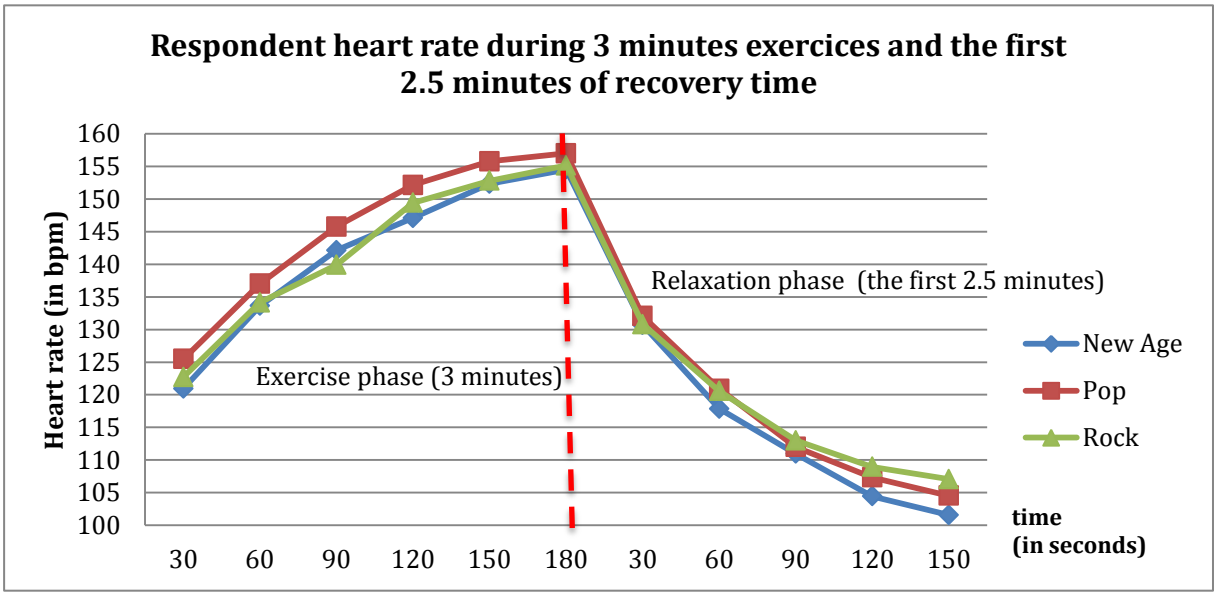

Figure 4. Recovery Time Comparation

CONCLUSION

From the experiment result, it can be concluded that musical genre significantly affects the post treadmill exercise recovery time. The fastest heart rate recovery time is obtained when the respondent has a relaxing time and hearing new age music. Further research can be done for analyzing the effect of others musical genre towards post treadmill exercise recovery time, such as jazz, classic, hip hop, and etc. with various musical tempo and considering respondent's musical preferences.

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REFERENCES

Bhavsar, S. D., Abhange, R. S. & Afroz, S. (2014). Effect of Different Musical Tempo on Post-Exercise Recovery in Young Adults. IOSR Journal of Dental and Medical Sciences, 13, 1, 60-64.

Iridiastadi, H. & Yassierli (2014) Ergonomi: Suatu Pengantar, PT Remaja Rosdakarya Offset, Bandung.

Kroemer, K.H.E., Kroemer, H.B. & Kroemer-Elbert, K.E. (2001) Ergonomics: How to Design for Ease and Efficiency, 2nd ed., Prentice Hall.

Manjunatha, S.N., Revathi, D.M.L., Sharan, A.T., Chandrakumar S.G. & Sapna, I. (2014) Cardiovascular responses to different musical tempo during post exercise recovery in healthy medical students, International Journal of Biological & Medical Research 5, 2, 4031-4035.

Montgomery, D.C. (2005) Design and Analysis of Experiments, John Wiley & Sons.

Orman, E.K. (2011) The Effect of Listening to Spesific Musical Genre Selections on Measures of Heart Rate Variability, National Association for Music Education, 30, 1, 64-69.

Palit, H.C. & Aysia, D.A.Y. (2015) The Effect of Pop Musical Tempo during Post Treadmill Exercise Recovery Time, Procedia Manufacturing, 4, 17-22.

Sanders, M.S. & McCormick, E.J. (1993) *Human Factors in Engineering and Design.* Mc Graw-Hill.

Sills, D. & Todd, A. (2015) Does Music Directly Affect a Person's Heart Rate? Emerging Investigators.

Thakur, A.M. & Yardi, S.S. (2013) Effect of Different Types of Music on Exercise Performance in Normal Individuals, Indian Journal of Physiology and Pharmacology, 57, 4, 448-451.