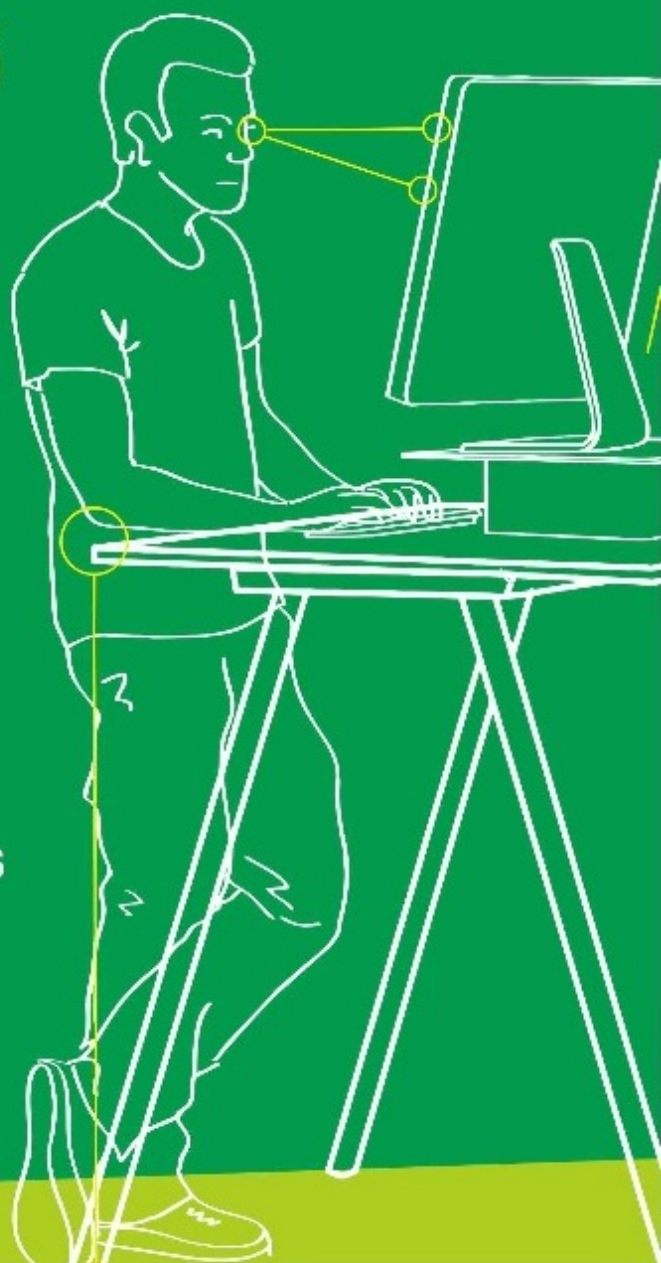




PROCEEDING SEANES 2016

THE 4TH SEANES
INTERNATIONAL CONFERENCE
ON HUMAN FACTORS AND ERGONOMICS
IN SOUTH-EAST ASIA

29 November - 1 December 2016
Bandung - Indonesia



Hosted by
**PERHIMPUNAN
ERGONOMI
INDONESIA**



in collaboration with





PROCEEDING

4th SEANES International Conference on Human Factors and Ergonomics in South-East Asia

Green Ergonomics – Sustainability, Productivity, and Well-being

**29 November – 1 December 2016
Bandung, Indonesia**



**PERHIMPUNAN
ERGONOMI
INDONESIA**



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Preface

Southeast Asian Network of Ergonomics Societies (SEANES) is a regional ergonomics society in Southeast Asia, founded by local ergonomics societies of few countries in the region. SEANES holds a biennial conference since 2010, which provides a forum for scientists, academics, and professionals from around the world, especially in the Southeast Asian region.

In 2016, **4th SEANES International Conference on Human Factors and Ergonomics in South-East Asia** will focus on “**Green Ergonomics: Sustainability, Productivity, and Well-being**”. Within this theme, SEANES 2016 Conference supports and expands the application of human factors and ergonomics with regards to recent local and global needs. This international conference aims to enhance the awareness of the importance of Human Factors Engineering (HFE) in various human activities and application domains, including product design, learning, communication, healthcare, transportation, defense and security.

Hosted by Indonesian Ergonomics Society (Perhimpunan Ergonomi Indonesia/PEI), in collaboration with Institut Teknologi Bandung (ITB) and Universitas Katolik Parahyangan (UNPAR), the committees publish this proceeding as publication of communities' participations on research papers.

Foreword from Conference Chair



It is with great pleasure we welcome you to the 4th SEANES International Conference on Human Factors and Ergonomics in South-East Asia (SEANES) 2016. Southeast Asian Network of Ergonomics Societies (SEANES) is a regional ergonomics society in Southeast Asia, founded by local ergonomics societies of few countries in the region. SEANES holds a biennial conference since 2010, which provides a forum for scientists, academics, and professionals in the field of ergonomics from around the world, especially in the Southeast Asian region.

This year SEANES 2016 Conference is organized for the fourth time and is hosted for the first time by Perhimpunan Ergonomi Indonesia (Indonesian Ergonomics Society) in collaboration with Industrial Engineering Department of Parahyangan Catholic University (UNPAR) and Industrial Engineering Department of Institut Teknologi Bandung (ITB). The conference is endorsed by International Ergonomics Association (IEA).

The theme “Green Ergonomics: Sustainability, Productivity, and Well-being” was chosen to reflect our passion to gather and engage ergonomists from academia and industries to exchange state-of-the-art knowledge and share their latest experience relevant to the application of human factors and ergonomics with regards to recent local and global needs. This international conference aims to enhance the awareness of the importance of Human Factors Engineering (HFE) in various human activities and application domains, including product design, learning, communication, healthcare, transportation, defense and security.

SEANES 2016 aims to engage academics and professionals in a number of interactive activities, i.e. keynote sessions, parallel paper presentation sessions, workshops, industry sessions, and also a welcome reception and a conference dinner. We have received the works of about 312 contributors from Indonesia, Malaysia, Singapore, Philippines, Thailand, India, Japan, China, Taiwan, Germany, Estonia, and Mexico through their submissions. Out of 102 research papers submitted, we selected 77 papers through a rigorous review process done by a board of international reviewers. These papers features a number of great and insightful articles related to several topics in the field of human factors and ergonomics.

Organizing the 4th SEANES Conference for the first time in Indonesia has been a great challenge. We knew that this conference would be impossible without the help from many people. We extend our gratitude to our strong and dedicated organizing committee, scientific committee, SEANES steering committee, international board of reviewers, keynote and workshop speakers, and also our generous sponsors.

Last but not least, we do hope that you enjoy the conference and your stay in Bandung. We also wish our international participants a memorable experience during your stay in Indonesia.

Johanna Renny Octavia Hariandja and Manik Mahachandra

(Conference Chairs)

On behalf of SEANES 2016 Organizing Committee

Foreword from President of PEI & SEANES



Selamat Datang di Bandung,

On behalf of the Southeast Asian Network of Ergonomics Societies (SEANES), we are very grateful for your participating in SEANES 2016. SEANES is a network of the International Ergonomics Association (IEA), and its societies are also IEA federated members, including Indonesian Ergonomics Society (PEI), Human Factors and Ergonomics Society of Malaysia (HFEM), Human Factors and Ergonomics Society of Philippines (HFESP), Human Factors and Ergonomics Society of Singapore (HFESS), and Ergonomics Society of Thailand (EST).

SEANES 2016 provides a great opportunity for sharing of ideas, research experiences and best practices in different areas of Human Factors & Ergonomics among academia, practitioners, and other stakeholders. Let's think of any possibility for collaborations in the future.

Among SEANES countries, we are heading similar challenges in improving our working conditions and promoting safety and health. Our stakeholders are looking forward to hearing our ergonomics success stories, practical ergonomics guidelines, simple ergonomics tool-kit, ergonomics approach adjusted to local conditions, more example of "ergonomics=economics", and etc. We are fortunate to have a draft of SEANES Ergonomics Checkpoints discussed in SEANES 2016. I believe that more programs can be initiated by SEANES such as ASEAN ergonomics month, training and certification, and etc. I believe that better collaborations can be established soon among individuals and societies.

This SEANES 2016 event is hosted and organized by Indonesian Ergonomics Society (Perhimpunan Ergonomi Indonesia/PEI), in cooperation with Institut Teknologi Bandung (ITB) and Universitas Katolik Parahyangan (UNPAR). Hence, I thank all the committee members for their hard work.

Finally, we hope you enjoy this SEANES 2016 event, fruitful workshop and successful conference, and also the most pleasurable stay in Bandung.

Thank you.
Sincerely,

Yassierli, Ph.D

President of Indonesian Ergonomics Society (PEI)
President of Southeast Asian Network of Ergonomics Society (SEANES)

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Scientific Committee

Adiatmika, I Putu Gede
Blewett, Verna
Caple, David
Charoenchai, Nivit
Charoenporn, Naris
Daruiz, Dian
Dewi, Dyah Santhi
Falzon, Pierre
Ha, Nguyen Thu
Hariandja, Johanna Renny Octavia
Hartono, Markus
Helander, Martin
Huda, Listiani Nurul
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Long, Jennifer
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Suk Kee Tie, Vivian
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Tan, Kay
Tey, Frederick
Tie, Vivian Suk Kee
Todd, Andrew
Toriizuka, Takashi
Ushada, Mirwan
Widyanti, Ari
Wijayanto, Titis
Yap, Edwin
Yassierli,
Yogasara, Thedy
Zink, Klaus J.

This is to certify that

Debora Anne Yang Aysia

has participated as a Presenter in

**THE 4TH SEANES INTERNATIONAL CONFERENCE
ON HUMAN FACTORS AND ERGONOMICS IN SOUTH-EAST ASIA**

on 28 November - 1 December 2016, Bandung - Indonesia



Yassierli, Ph.D.
President of SEANES
President of Indonesian Ergonomics Society



Dr. Johanna Renny Octavia Hariandja
Conference Chair of SEANES 2016



The Effect of Musical Genre during Post Treadmill Exercise Recovery Time

Herry Christian PALIT, Debora Anne Yang AYSIA
Industrial Engineering Department, Petra Christian University

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

(continue)

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

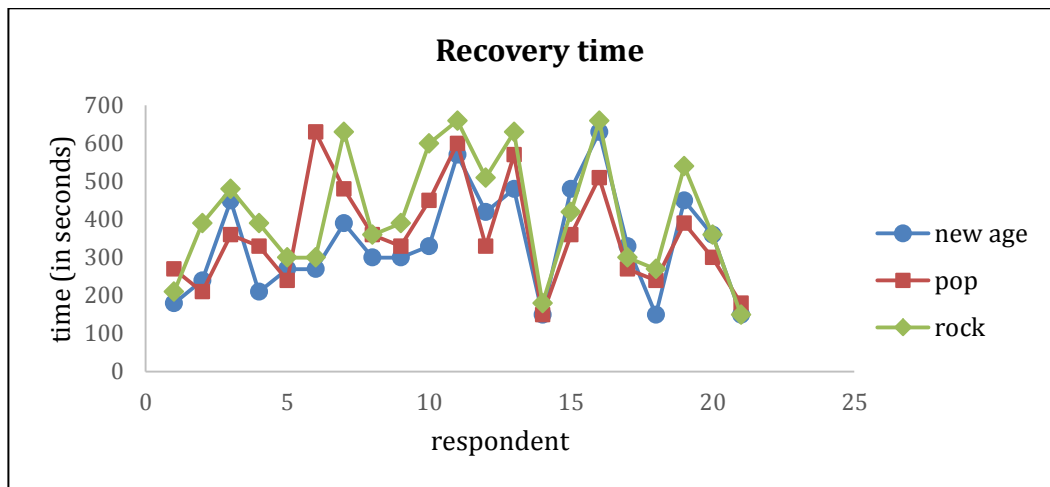


Figure 1. Recovery Time

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

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%

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.

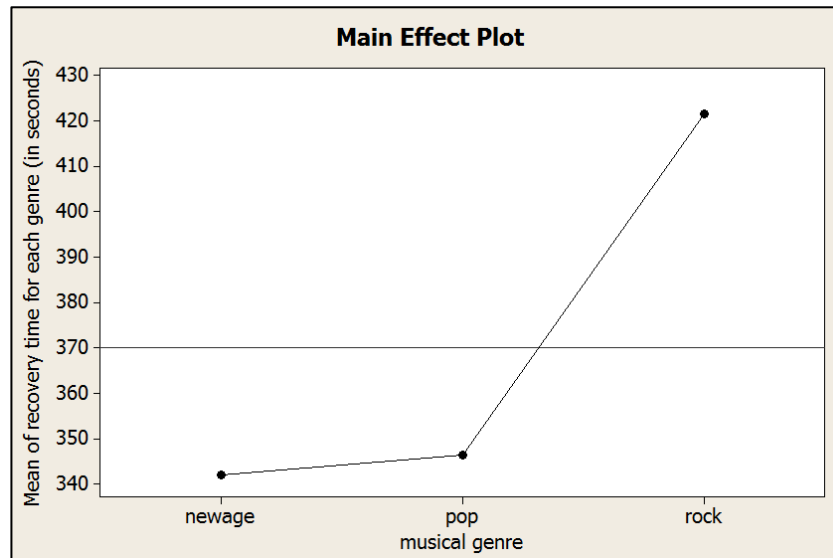


Figure 3. Main Effect Plot for Musical Genre

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.

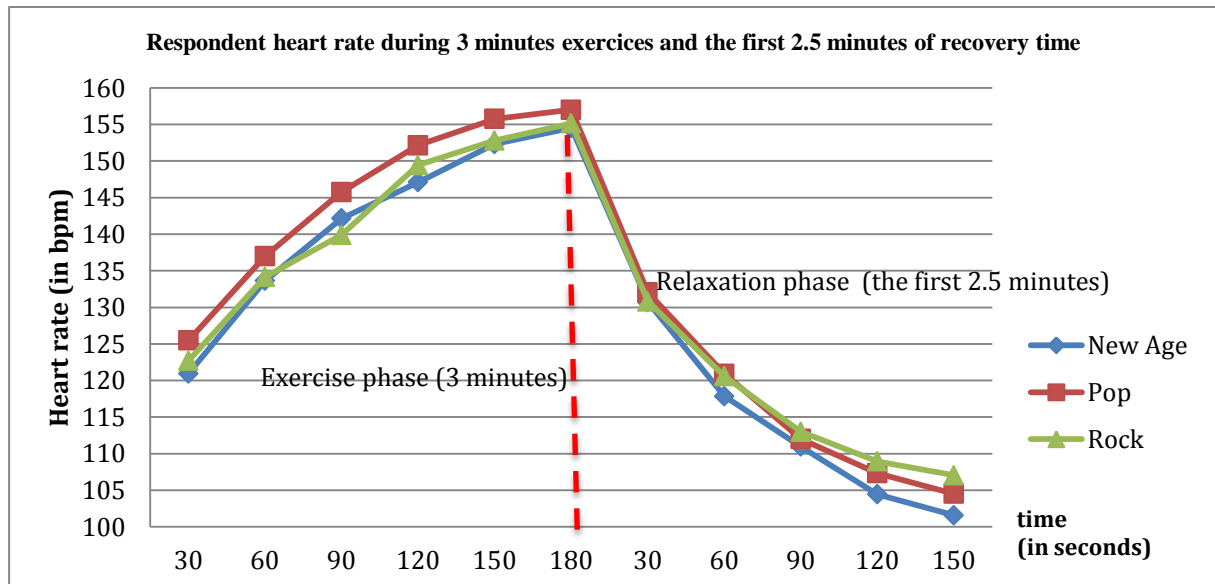


Figure 4. Recovery Time Comparison

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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