

Experiment Report:

Verification of effects on reducing feelings of fatigue during exercise using the Yamaha BODiBEAT

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■ Purpose of the Experiment

- To measure RPE (Rating of Perceived Exhaustion) and comfort level in jogging, under different kinds of song preference and different song tempos.
- Using those measurements, to examine the importance of song preference on jogging and the importance of matching tempo to the jogging pace.

■ Expected Effect

- Subject should feel comfortable and less fatigue when the song tempo matches to the exercise steps and the music is likable.
- Subject should feel comfortable when the tempo matches the exercise pace, even if the music is not likable to some degree.

■ Date of Experiment

Late October -- Beginning of November, 2006

■ Place of Experiment

Tokyo Women's College of physical education: for female examinees
Daito Bunka University: for male examinees

■ Experimental Examinees

20 persons (10 male, 10 female)

■ Experiment Procedure

Before Testing

1. Initial Questionnaire

Examinees filled in a questionnaire in advance, giving their response to questions on:

- Exercise frequency (jogging)
- Listening to music during jogging
- Music likes: genre/artist/song
- Music dislikes: genre/artist/song

※ This questionnaire was used to determine the proper music for utilizing in the experiment.

Testing Day

2. Song Monitoring

Before testing, examinees were made to listen to about 50 songs and assign them a preference rating in three grades: dislike, no preference and like.

Dislike No preference Like
| _____ | _____ |

3. Song selection for testing

Custom playlists of six songs were created for each examinee according to their preference indications and following the format below. (For example, examinee A would be assigned out of the 50 songs song numbers 3, 7, 26, 28, 42 and 45.)

Song	Examinee's rating	Song tempo and running pace
(a)	Like	Matching
(b)	Like	Non-matching
(c)	Dislike	Matching
(d)	Dislike	Non-matching
(e)	No preference	Matching
(f)	No preference	Non-matching

* "Matching" indicates the song tempo is 145-170 bpm.

* "Non-matching" indicates the song tempo is 100-120 bpm or 185-220 bpm.

* Songs (a), (c) and (e) are selected to be as close in tempo as possible, within a range of 5 bpm.

4. Speed Measurement

The exercise treadmill speed was adjusted to match the tempo of songs (a), (b) and (f), while the examinee ran on the treadmill. This naturally keeps the examinees running in time with the song tempo.

5. RPE Measurement

Each examinee was made to run on the treadmill according to the following procedure.

1) The treadmill speed was adjusted to match the tempo of song (a), then the examinee started running on it.

* The song was not played back until the speed of the treadmill reached the same pace as the song tempo.

2) Song (a) was played back, and the RPE and comfort level were checked.

3) Song (b) was played back, and the RPE and comfort level were checked.

* The treadmill speed was maintained at the same pace as the tempo of song (a).

4) The treadmill speed was changed to the tempo of song (c) [if different from that of song (a)].

* Playback of song (b) continued until the treadmill speed matched up with the tempo of song (c).

5) Song (c) was played back, and the RPE and comfort level were checked.

6) Song (d) was played back, and the RPE and comfort level were checked.

* The treadmill speed and the examinee's pace were maintained at the same pace as the tempo of song (c).

7) The treadmill speed was changed to the tempo of song (e) [if different from that of song (c)].

* Playback of song (d) continued until the treadmill speed matched up with the tempo of song (e).

8) Song (e) was played back, and the RPE and comfort level were checked.

9) Song (f) was played back, and the RPE and comfort level were checked.

* The treadmill speed and the examinee's pace were maintained at the same pace as the tempo of song (e).

* Song playback time was from a minimum of one minute to a maximum of three minutes. When the RPE measurement was finished, playback of the next song was started.

	Treadmill speed	Song playback	Examinee's pace
1)	Same as song (a)	None	Same as treadmill speed

	tempo		
2)	Song (a)	(a)	Adapted to song (a) tempo
3)	Song (a)	(b)	Maintained at song (a) tempo
4)	Song (c)	(b)	Same as treadmill speed
5)	Song (c)	(c)	Adapted to song (c) tempo
6)	Song (c)	(d)	Maintained at song (c) tempo
7)	Song (e)	(d)	Same as treadmill speed
8)	Song (e)	(e)	Adapted to song (e) tempo
9)	Song (e)	(f)	Maintained at song (e) tempo

■ Equipment and other materials

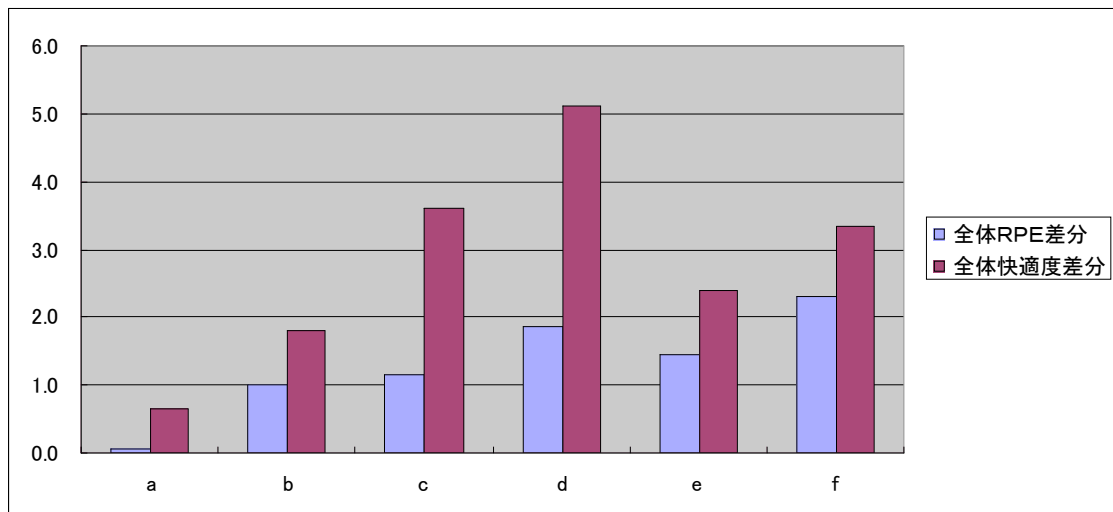
1. Questionnaire
2. Songs (about 50 songs; the genre/song chosen based on the questionnaire)
3. Headphone, MP3 player (for monitoring music playback)
4. Music player

■ Experimental Results (As for numerical value, refer to the other excel file.)

Fig. 1 Delta between RPE/Comfort value for each song and minimum RPE/Comfort value on the denominator of Minimum RPE/Comfort.

- Non-matching song's RPE is about one or two larger than minimum.
- Non-matching song's comfort level is about 2-5 larger than minimum.
- Comfort level's difference is larger than RPE difference [especially for songs (c) and (d)].

That is, although the speed is the same (or mechanical/physiological intensity is the same), the RPE differs by about 3 and the comfort level differs by about 5, depending on the song. The comfort level in particular is affected by the music.



- Song (a): Liked; matching the tempo
 Song (b): Liked; not matching the tempo
 Song (c): Disliked; matching the tempo
 Song (d): Disliked; not matching the tempo
 Song (e): No preference; matching the tempo
 Song (f): No preference; not matching the tempo

 Fig. 2 Delta between RPE value for each song and minimum RPE value on the denominator of Minimum RPE.

- Male: Non-matching song's RPE is about 1 – 2.5 larger than minimum.
- Female: Non-matching song's RPE is about 0.7 – 2 larger than minimum.
- Difference for males is larger than that for females [especially for songs (b), (d) and (f).]

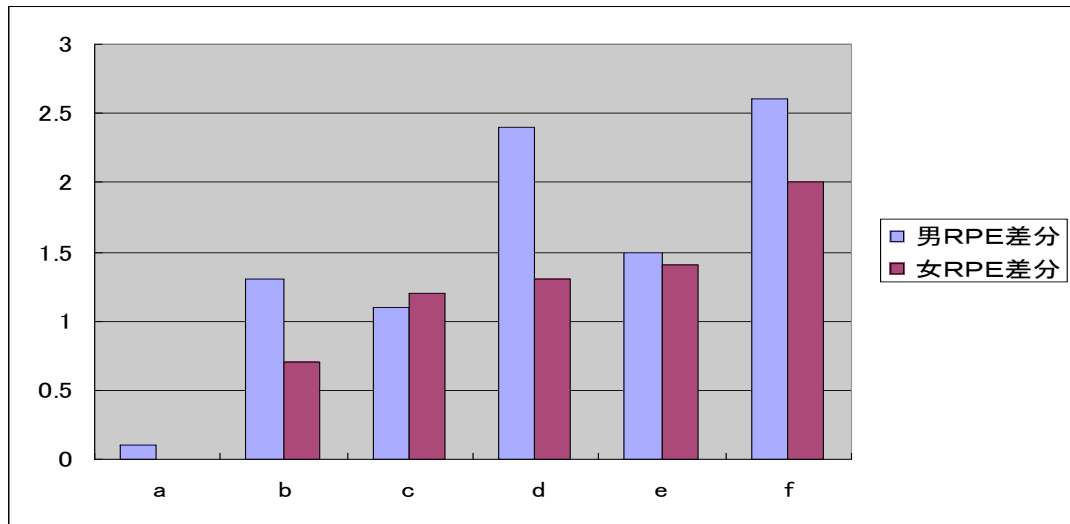


Fig. 3 Delta between comfort value for each song and minimum comfort value on the denominator of Minimum comfort.

- Male: Non-matching song's comfort level is about 1 – 6 larger than minimum.
- Female: Non-matching song's comfort level is about 1 – 4 larger than minimum.
- No significant tendency is seen for males and females. Males show larger value for songs (b), (c), (d), (e) and (f). Females show larger value for songs (c), (d), (e) and (f).

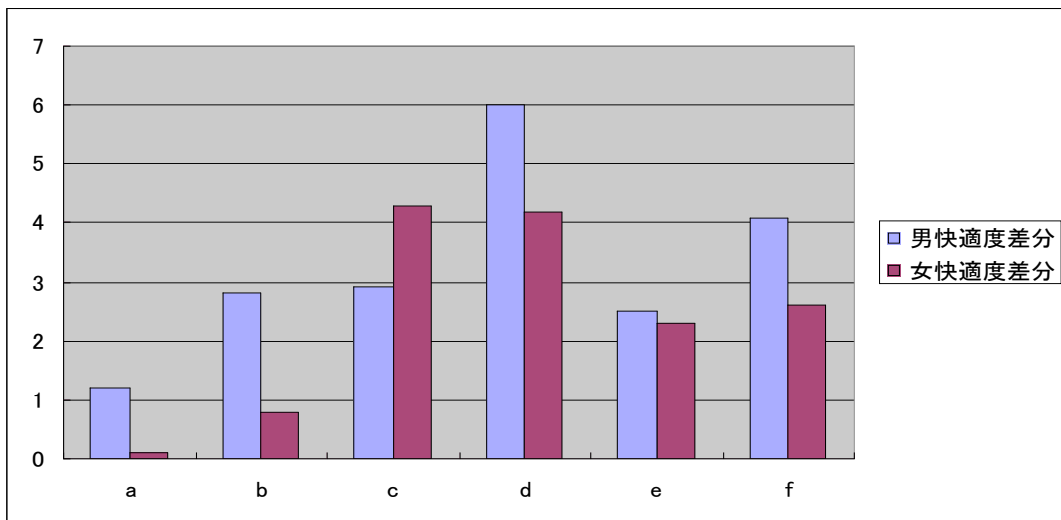


Fig. 4 RPE average amount for all examinees [horizontal axis shows song (a) – (f)]

- RPE is in the range of “very effortless” – “somewhat hard.”
- RPE value differs up to a maximum of 4 between different examinees although they run at the same pace.

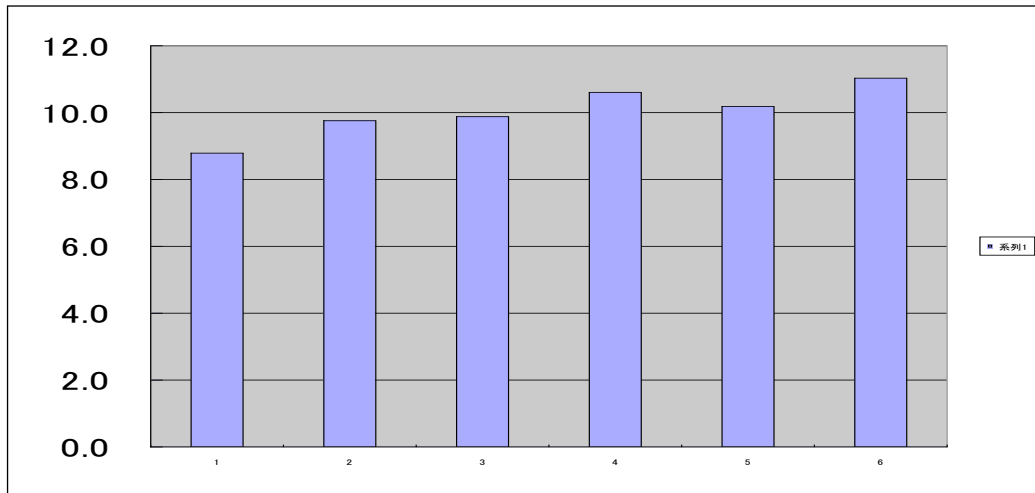
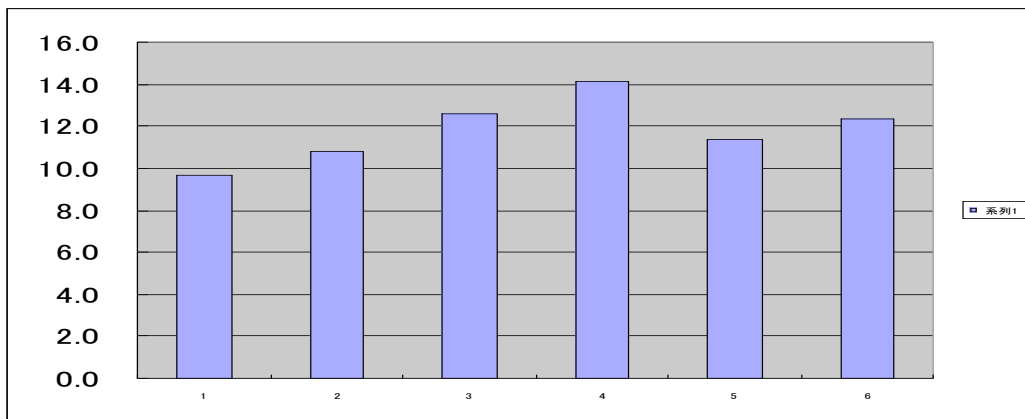


Fig. 5 Average amount of the comfort level for all examinees [horizontal axis shows song (a) – (f)]

- The comfort level is in the range of “very comfortable” – “somewhat uncomfortable.”
- Comfort level value differs up to a maximum of 4 between different examinees although they run at the same pace.



Conclusion

In this experiment, it is quantitatively shown that the RPE differs depending on the music being listened to, even when running pace (or mechanical/physiological intensity) is constant. The comfort level also differs and the difference is larger than RPE. In other words, the targeted results were achieved.

Supplementation:

* The RPE (Rating of Perceived Exhaustion) is a variable advocated by Swedish physiological scholar Borg and imported to Japan by Onodera and Miyashita as a "subjective exercise strength."

RPE shows there is correlation between the heart beat and the subjective strength in exercising.

*Comfort Level is set for this experiment as follow.

Comfort Level

20	
19	Extremely uncomfortable
18	
17	Very uncomfortable
16	
15	Uncomfortable
14	
13	Somewhat uncomfortable
12	
11	Comfortable
10	
9	Very Comfortable
8	
7	Extremely Comfortable
6	