The effect of in-built Heart Rate monitor sports watches on different exercise intensities

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Abstract
The investigation was designed to assess differences in mean values in heart rate responses at different intensities using a Fitbit Charge HR, Garmin Forerunner 220 and the Polar FT 1. Experimenter protocol was designed to illustrate HR changes at different intensities. Garmin illustrates non-valid responses at higher levels of intensity in comparison to the Polar FT-1. Fitbit Charge HR deemed valid responses with the Polar FT-1.

Introduction
The purpose of the present study is to assess the discrepancies in testing the efficiency and reliability of GPS heart rate monitors (Fitbit, Polar, Garmin heart rate monitor). Heart rate monitors were originally marketed to athletes but with the new modification it has now appealed to more recreational athletes interested in health and weight control, (Lee and Groliek, 2014).

Many studies have provided data on various HR monitors (Lee & Groliek, 2011; Gamelin et al, 2006), but in contrast limited scientific research has been able to state their validity and accuracy through results. The primary data gathered will expand from earlier studies such as (Lee and Groliek, 2011; Gamelin et al, 2006) and focus will be specific to assessing discrepancies in varying the activity and intensity to illustrate heart beat responses in GPS specific sports watches.

The present study will compare three different heart monitors in assessing discrepancies in data. Through the study it should enable other researchers to make a more informed decision on whether to purchase and utilize the Fitbit and other HR monitors to improve physical performance.

Methodology
Two sport students volunteered to participate in the study; a PAR-Q was issued to the subjects to ensure there were no current illnesses or injury during the testing period. Prior to the conduction of the experiment the subjects were instructed to not ingest any caffeine or energy supplement that would have any physiological effects on the body. All subjects were familiarized with the testing protocol prior to the experiment in which each subject completed a consent form as confirmation to the testing procedure. Subjects mean (+SD) age (19.6 ± 0.9); all the subjects were weight measured before each trial using the Fitbit Aria Wi-Fi Smart Body Scale. Height measurements were recorded during the first trial of the protocol in which was used for each trial to work out the body mass of each subject prior to each test.

Experimental Protocol
A randomized trial was conducted using 3 popular GPS wrist worn devices, the watches were categorized into 3 trials; trial 1 (Fitbit & Polar), trial 2 (Polar & Garmin) and trial 3 (Polar). The tests were performed using the Life Fitness 95St Treadmill. Each trial consisted of 5 phases over a period of 5 minutes per phase. Phase 1: standing phase 2- slow walk (3kp), phase 3- gentle jog (6.4kp), Phase 4- running (9.6kp) and the final phase consisted of the subject choosing a comfortable speed to continue for an additional 5 minutes. Each trial lasted just over 25 minutes per trial for each subject tested; the devices were worm on the wrist throughout each test including the Polar electro belt being worn below the chest region for the Polar FT 1. Prior to the exercise each subjects heart rate was retrieved during pre-testing and one minute after the intermittent exercise providing resting heart rate and recovery heart rate, the timings were measured using the Easytime stopwatch for each interval. Each subject was tested once a week over a randomized trial applying exactly the same protocol; humidity and temperature of the lab was measured pre and post to testing conditions using the Techno line WS 9032 weather station.

Discussion
With the forever advancements of GPS wrist worn devices it is imperative that GPS devices are valid and reliable in order to sustain a high standard. Our study has identified that measuring heart rate there is a significant difference between various GPS models (Garmin Forerunner 220), Fitbit Charge HR and Polar FT 1 (P < 0.03); despite the accuracy of the Polar HR Monitor found by Gamelin, Katch & Katch, 2015. Esco et al. (2011) found after conducting a study on the Polar FT 1 Heart Rate Monitor, the author questions the reliability of the device; this may explain the significant difference (P= 0.03) that was found in the present study.

Results

From the trials conducted there were positive correlations from the Fitbit and Polar and a negative correlation from the Garmin in comparison to the other GPS devices. Fig 1 illustrates the mean values gathered from the tests for participant 1 and Fig 2 illustrates the gathered results from the conducted tests. The T-Test between the Fitbit Charge HR and the Polar HR observed no significant difference in mean value scores (P=0.16). However the Garmin and the Polar HR revealed a significant difference on the second trial (P=0.01). It is also observed that there was a significant difference between the Garmin and Polar Heart Rate devices at a higher intensity (P<0.05); the T-Test between the Fitbit Charge HR and the Polar HR observed a significant difference between the devices for the trial (P=0.03). Garmin and Polar HR observed no significant difference between the devices (P=0.28), no significant differences were observed between the Fitbit and the Polar (P=0.21).

Discussion
Despite this discrepancy it has been found that there is no significant difference between the Garmin and Polar sport watches (P= 0.28), when tested in the two participants. This might explain why the Garmin watch has been associated with high accuracy through various intensities of exercise, whilst also being popular with elite athletes, which require accurate technology (McArdle, Katch & Katch, 2015; Meyer & Boll, 2014). This is due to it correlating to the readings of the ‘gold standard’ Polar HR monitor (McArdle, Katch & Katch, 2015).

The Polar heart rate monitor has been hypothesised as the gold standard; Mannmenn et al (2012) found at walking pace, the Fitbit HR monitor had a disparity of +/- 5%, devoid of more intensive exercise. Regardless of this, the Fitbit and Polar sport watches (P=0.21) were found to have no significant difference throughout the increasing intensities of the test. This illustrates the dissimilarities of the two devices; however this finding supports Noah et al (2013) study, concluding that the Fitbit was valid and reliable. This only assessed steps taken and energy expenditure for the Fitbit monitor; as well as exercising at a lower intensity. This suggests that this study can be regarded as invalid due to the intensity and lack of HR findings.

Through the expansion of Lee & Gorelick, (2011); Gamelin et al, (2006) earlier studies, the primary data collected revealed that the Fitbit Charge HR and Polar FT 1 correlated positively (P=0.21) during the 5 phases of all 3 trials. McDermott et al (2016) pilot study performed a similar protocol; the subjects completed 3 five minute exercises at various intensities with 48 hour separation between both trials.

Conclusion
The results of this study identified that the Polar FT 1 and the Fitbit Charge HR are valid GPS HR monitors with no significant difference (P=0.21). In addition to the study the Fitbit and Garmin should have been tested over more trials to further develop this observation. The Garmin was found to be the less accurate device during the experiments (P=0.28), significant differences found between monitors (P=0.03). Further participants are required to deem testing mechanisms valid.

References