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# Validity of Optical Blood Flow Heart Rate Monitors

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## ABSTRACT

**PURPOSE:** Validate the Schoche (SC) (Rhythm™), Basis B1 Band (BB) (BASIS Science, Inc.), and Mio Alpha (MA) (Physical Enterprises, Inc.) wireless heart rate monitors. **METHODS:** Fifteen college students (males, n=11, age=27±5yrs; females, n=4, age=27±6yrs) participated. All participants simultaneously wore the SC on left forearm, the BB on the right wrist, the MA on the left wrist, and Polar heart rate strap on their chest. Participants' resting heart rate was measured twice prior to exercise. The exercise protocol consisted of one 30-minute bout of continuous walking and running in which the treadmill speed increased every 5-minutes. The treadmill started at 2 mph and completed at 6 mph, followed by 3 minutes of cool down. HR was recorded every minute from each monitor including the Polar HR monitor as a criterion measure. **RESULTS:** Average HRs (means ± SD) for Polar HR, SC, MA, and BB were 113±32, 110±34, 117±32, and 111±27. A strong Pearson's correlation coefficient was observed with the SC (r =.88) and the MA (r =.75), but a weak correlation coefficient was found with the BB (r =.41), p>0.01. Corresponding absolute error rates were 6.0±12.5%, 11.7±24.2%, and 18.2±21.3%. ANOVA and post hoc analyses with Bonferroni revealed non-significant differences between the SC, MA, and BB (p > 0.05) compared to the Polar HR. **CONCLUSION:** The results demonstrate that the wireless wrist-oriented heart rate monitors provide an accurate measurement of HR during exercise. However, further research is needed to validate these monitors with a larger sample in different environments

## INTRODUCTION

- Heart rate (HR) monitors are a valuable device for individuals who are interested in improving and/or tracking fitness.
- These devices can be worn on the wrist or forearm and detects HR by use of an optical blood flow sensor without a chest strap. However, little is known about the validity of these commercially available HR monitors.
- The purpose of this study was to validate the Schoche (SC) (Rhythm™), Basis B1 Band (BB) (BASIS Science, Inc.), and Mio Alpha (MA) (Physical Enterprises, Inc.) wireless heart rate monitors.

## METHODS

- Fifteen college students participated in this study.

	Female (N=4)	Range	Male (N=11)	Range
Age (y)	26.5 ± 5.7	23 - 35	27.3 ± 5.1	22 - 37
Height (cm)	164.3 ± 6.7	158.5 - 174	181.3 ± 4.0	175 - 186.5
Weight (kg)	60.7 ± 7.1	52.5 - 69.7	84.8 ± 14.5	67.63 - 109.2
BMI (kg · m <sup>2</sup> )	22.4 ± 1.1	20.9 - 23.4	25.7 ± 4.0	21.3 - 33.9

## METHODS

### Instruments

- All participants simultaneously wore the SC on left forearm, the BB on the right wrist, the MA on the left wrist, and Polar heart rate strap on their chest.



- The Schoche (SC) (Rhythm™) measures HR, calories burned, distance, speed, pace, and controls your music.
- The Basis B1 Band (BB) (BASIS Science, Inc.) contains a 3D accelerometer to measure movement and is able to measure skin temperature, the ambient temperature, and the galvanic skin response when engaged in activity.
- The Mio Alpha (MA) (Physical Enterprises, Inc.) is accurate at high speeds, has 3 user-settable heart rate zones, shows time, and has an exercise timer.
- All of these devices use optical sensors to measure blood flow, are waterproof, and use Bluetooth technology to connect to a smartphone or tablet to display results.

### Procedures

- The exercise protocol consisted of one 30-minute bout of continuous walking and running in which the treadmill speed increased every 5 minutes.
- HR was recorded every minute from each monitor including the Polar HR monitor as a criterion measure.

## RESULTS

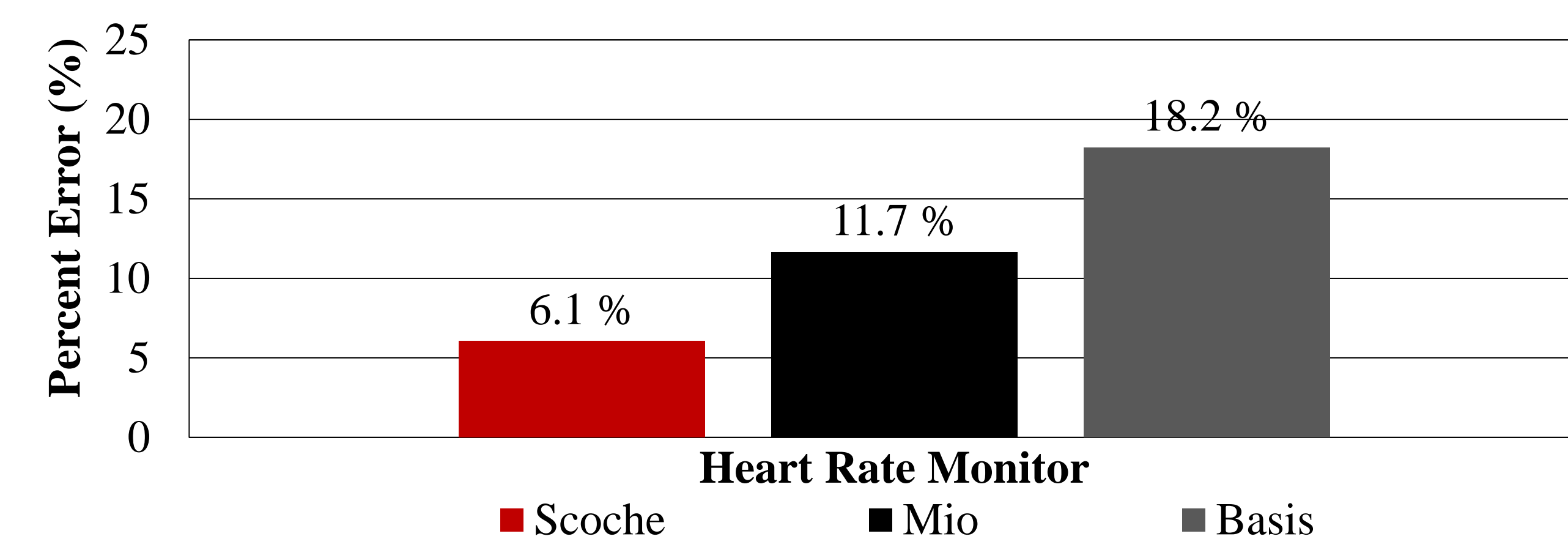


Figure 1. Mean Absolute Percentage Error for Heart Rate Monitors

## RESULTS

Figure 2. Bland-Altman Plots for Heart Rate Monitors

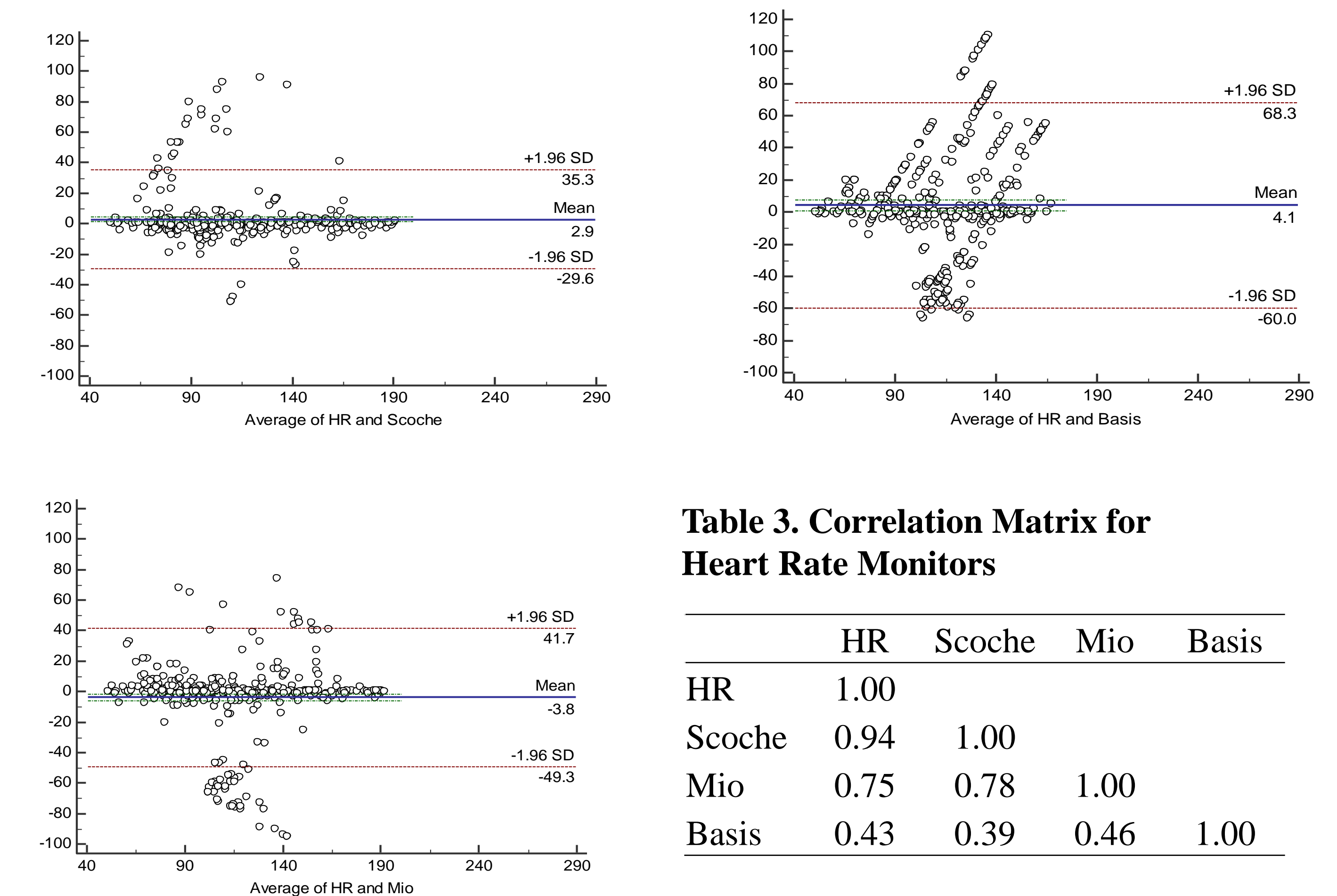


Table 3. Correlation Matrix for Heart Rate Monitors

	HR	Schoche	Mio	Basis
HR	1.00			
Schoche	0.94	1.00		
Mio	0.75	0.78	1.00	
Basis	0.43	0.39	0.46	1.00

Table 2. Mean Heart Rate During Exercise Protocol for Heart Rate Monitors

	Polar HR	Schoche Rhythm	Mio Alpha	Basis B1 Band
Resting	69.9 ± 12.9	70.2 ± 13.5	69.1 ± 13.6	67.5 ± 12.5
2 mph	83.5 ± 11.4	86.2 ± 16.0	98.9 ± 30.7	106.0 ± 31.2
3 mph	91.7 ± 13.0	84.1 ± 17.5	107.4 ± 31.0	113.2 ± 28.4
4 mph	108.1 ± 14.8	100.7 ± 19.9	109.2 ± 16.3	102.1 ± 18.1
5 mph	139.2 ± 21.3	137.2 ± 22.4	136.8 ± 23.0	119.1 ± 16.3
6 mph	157.3 ± 18.6	155.4 ± 22.5	150.2 ± 22.1	130.5 ± 21.8
Cool Down	122.9 ± 20.8	125.1 ± 23.4	123.8 ± 23.7	121.7 ± 18.3

## CONCLUSIONS

- The results demonstrate that the wireless wrist-oriented heart rate monitors provide an accurate measurement of HR during exercise.
- However, further research is needed to validate these monitors with a larger sample in different environments