

Comparing wrist actigraphy to a novel wearable (Actigpatch): Nonparametric activity estimation

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INTRODUCTION

Wrist actigraphy is a standard measure for monitoring naturalistic sleep patterns; however, data quality is compromised if participants remove the device for daily activities (e.g., baths, exercise).

The Actigpatch is a novel, adhesive water-resistant wearable that we have previously demonstrated as comparable to wrist actigraphy for traditional sleep-wake estimation¹.

Here we compare assessment of nonparametric activity indexes.

STUDY PROCEDURES

Thirty-five adults (21F; mean: 32.9±13.2 yrs) followed fixed sleep schedules and contributed ≥four days/nights of data (range: 4-14 [mean: 9] nights).

Comparison devices

Participants simultaneously wore the Micro MotionLogger actigraph (Ambulatory Monitoring Inc., Ardley, NY) on their non-dominant wrist and the Actigpatch – a 0.5in² circuit board enclosed in a water-resistant adhesive (Circadian Positioning Systems, Newport, RI) – over the triceps of their dominant arm.

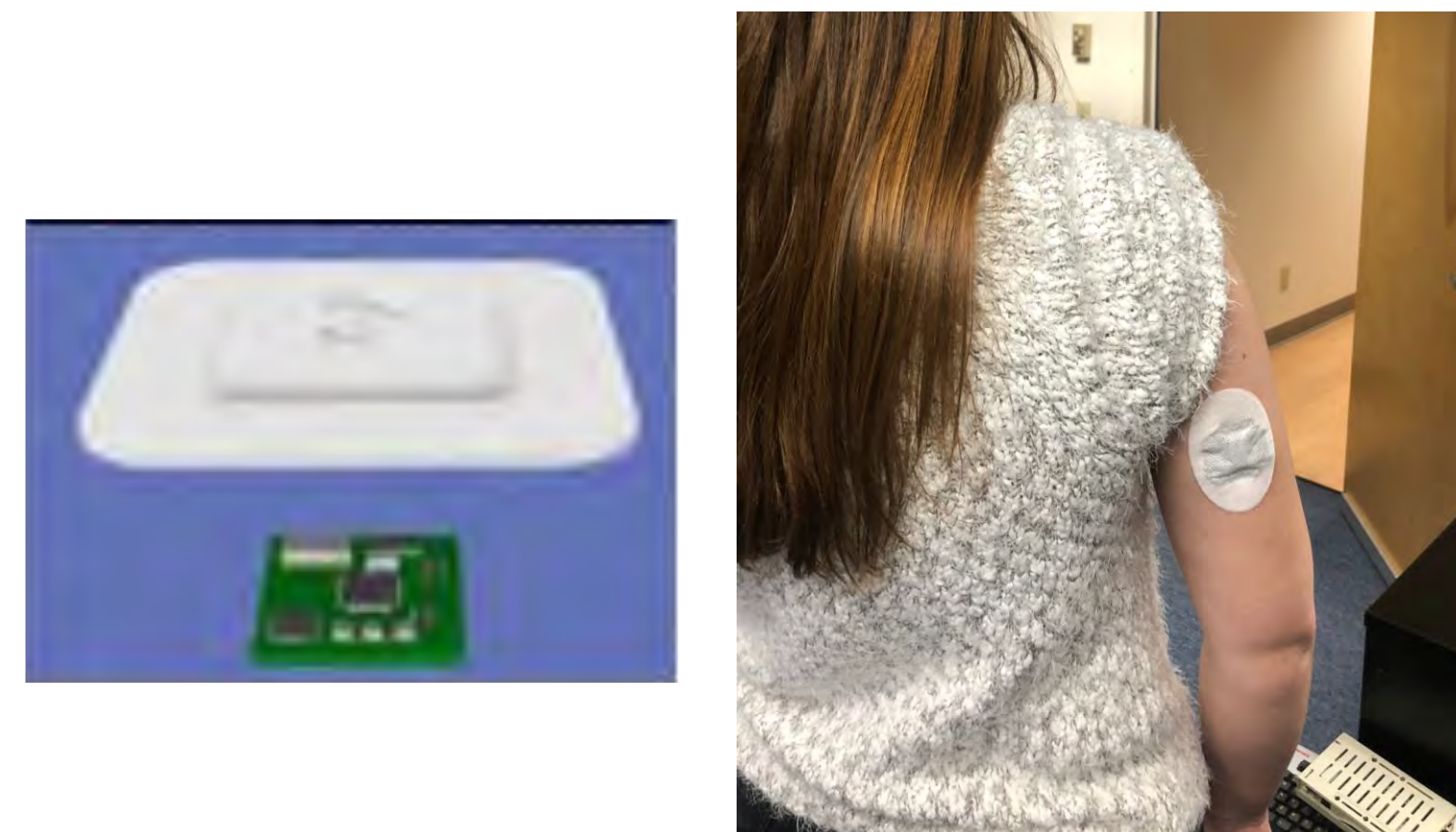
Actigraphy

AMI Micro MotionLogger



Experimental device

CPS Actigpatch



Both devices recorded tri-axial accelerometry in one-minute epochs with integrated activity counts derived from each device's software. Sleep-wake scores are not part of the current analysis.

Data Processing

Key non-parametric parameters of diurnal activity were derived using the "nparAct" R package². These parameters are based on activity counts, not derived sleep-wake scores, thereby bypassing differences between sleep-wake algorithms and their application in different devices.

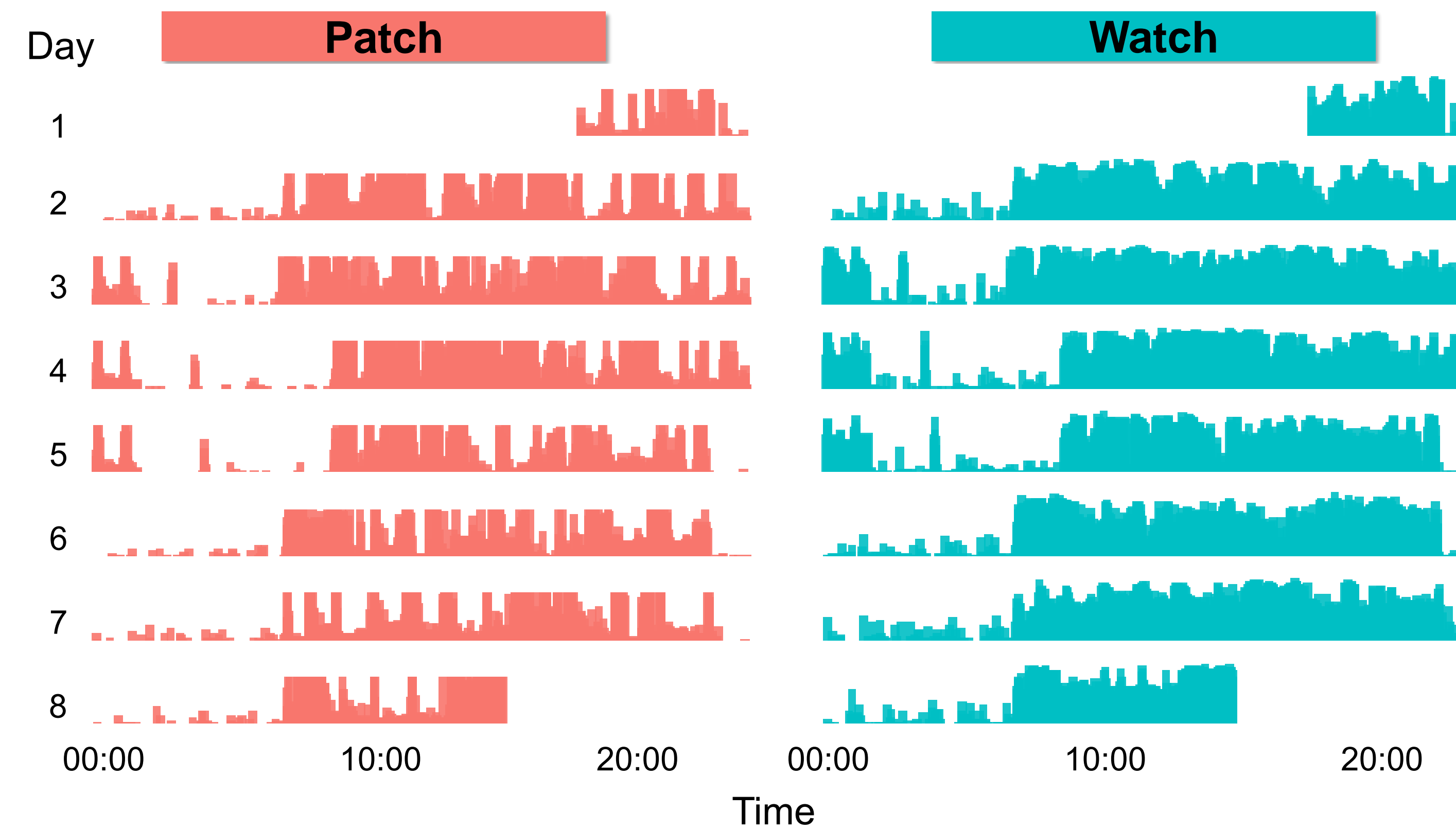
Variable	Range	Definition
Interdaily stability (IS)	0-1	Stability of rest-activity rhythms between subsequent days
Intradaily variability (IV)	0-2	Fragmentation of periods of activity from periods of rest within 24-hour rest-activity rhythm
Timing of five hours of lowest activity (L5onset)	00:00-23:59	Onset of the least active consecutive five hours, in 24-hour time
Timing of ten hours of highest activity (M10onset)	00:00-23:59	Onset of the most active consecutive ten hours, in 24-hour time
Relative amplitude (RA)	0-1	Difference between M10 (mean activity level of most active ten hours) and L5 (mean activity level of least active five hours), normalized by their sum (M10-L5/M10+L5)

Intraclass correlation coefficients (ICCs) were calculated to assess agreement between the devices on these five variables.

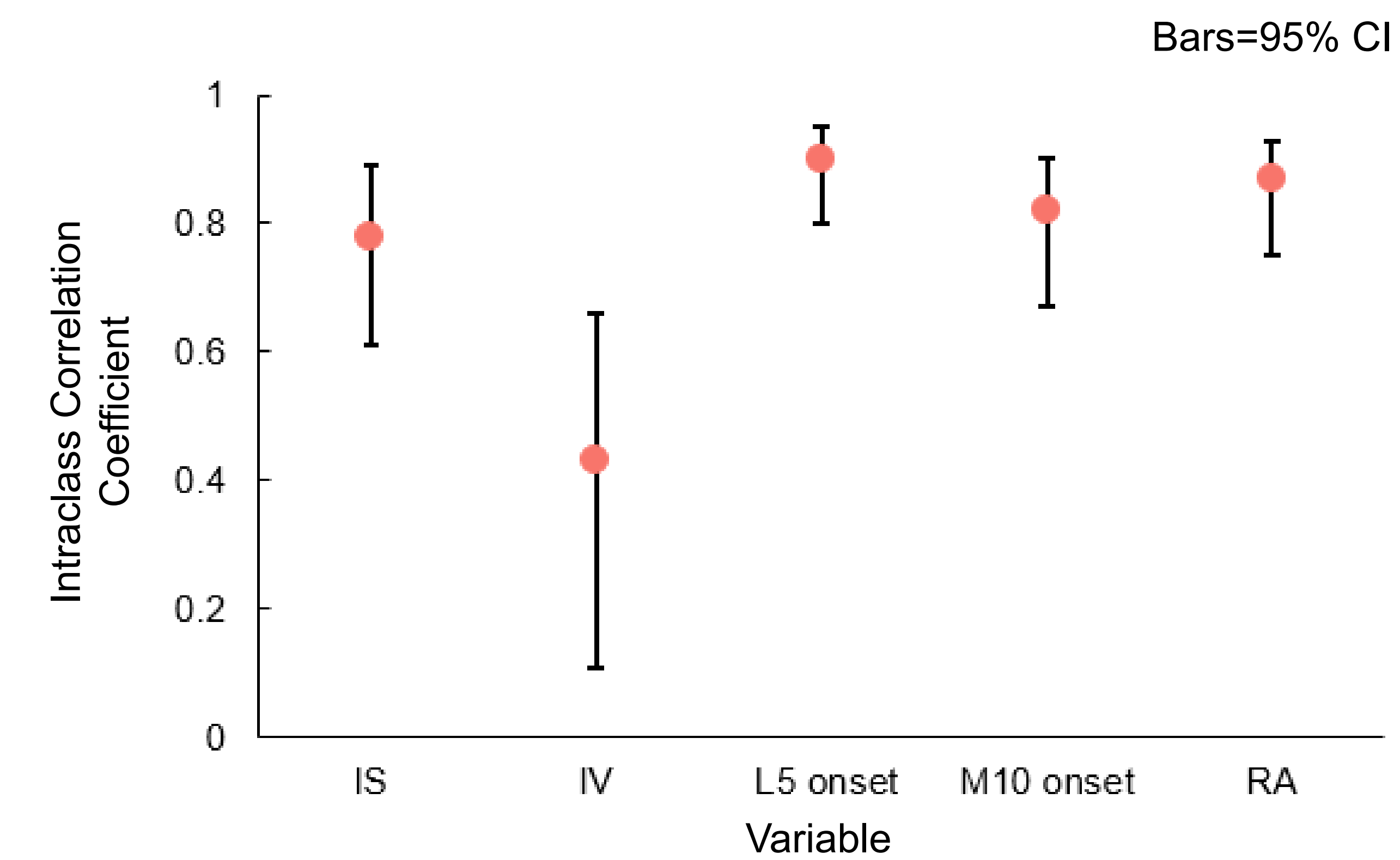
Bland-Altman plots were generated to evaluate device bias as a function of the watch-derived non-parametric parameters.

REFERENCES

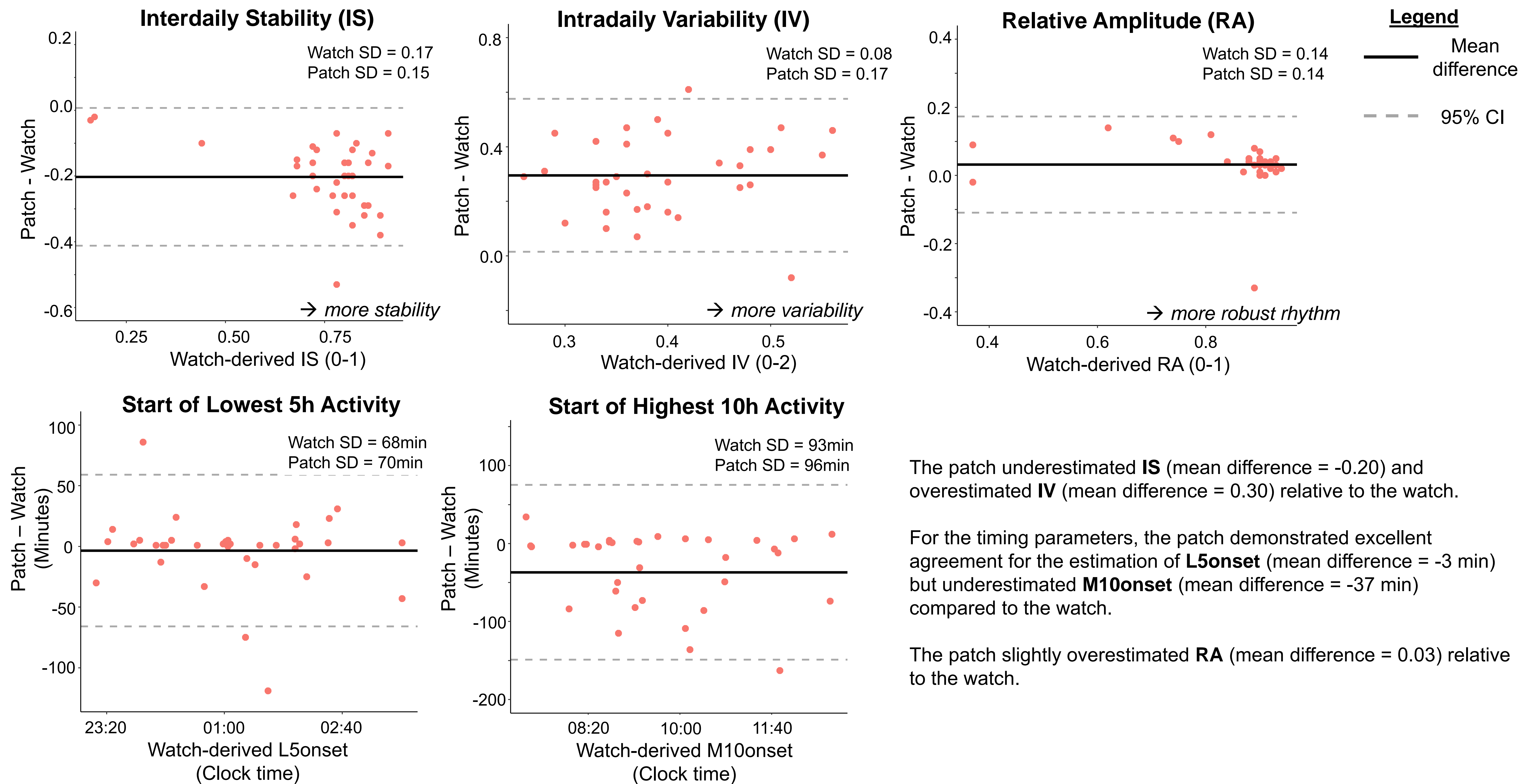
RESULTS I: REPRESENTATIVE ACTIVITY PLOTS FROM ONE PARTICIPANT



RESULTS II: TWO-WAY CONSISTENCY ICCs



RESULTS III: BLAND-ALTMAN PLOTS



The patch underestimated **IS** (mean difference = -0.20) and overestimated **IV** (mean difference = 0.30) relative to the watch.

For the timing parameters, the patch demonstrated excellent agreement for the estimation of **L5onset** (mean difference = -3 min) but underestimated **M10onset** (mean difference = -37 min) compared to the watch.

The patch slightly overestimated **RA** (mean difference = 0.03) relative to the watch.

DISCUSSION

Adding to our prior evidence that these two devices offer similar sleep-wake estimation using traditional algorithms, the present data indicate the Actigpatch offers good agreement to the MotionLogger for nonparametric analyses of **IS**, activity **timing**, and **RA**.

Agreement was not as good for **IV**, with the Actigpatch showing more intraday variability than the watch, perhaps due to the triceps placement.

The Actigpatch is unobtrusive, water-resistant, and can be worn continuously for three weeks. Thus, it has potential benefits for studies of individuals who struggle with success wearing wrist-worn devices.

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2. Blume, C., Santhi, N., & Schabus, M. (2016). "nparACT" package for R: A free software tool for the non-parametric analysis of actigraphy data. *MethodsX*, 3, 430-435. <https://doi.org/10.1016/j.mex.2016.05.006>