TITLE: Performance of Basis Peak and Microsoft Band 2: A Validity and Reliability Study

ABSTRACT: Heart rate data is useful in studying stress levels, workload, and fatigue while participants perform cognitively demanding tasks (Goldberger, Goldberger, & Shvilkin, 2012). The standard in collecting physiological heart rate (HR) data is the use of electrocardiogram (ECG). Unfortunately the use of ECG can be time consuming, costly, and requires specialized training. From a participant’s perspective, it can seem invasive, due to the attaching of electrodes to the chest. A feasible alternative to physiological data collection is the use of consumer fitness-tracking devices. There have been no previous studies to determine whether or not wrist-bands are valid for measuring cognitive tasks. These devices are non-invasive wristbands with special skin sensors that measure heart rate and galvanic skin response (GSR), which is an established measure of workload and stress (Shi, Ruiz, Taib, Choi, & Chen, 2007). The objective of this study to validate fitness-tracking devices as an alternative to ECG and thus make the inclusion of physiological data in psychological research more accessible.

BACKGROUND: Past studies have verified the reliability of fitness tracking devices such as recording and analyzing data for such devices (Goodie, Larkin, & Schauss, 2000; Terbizan, Dolezal, & Albano, 2002). In the first study, the device used was placed around the sternum, which is a much more obtrusive and inconvenient placement than our present study. In our present study, the fitness tracking devices will be placed across the wrist. Both studies did not measure GSR (a predictor of stress), which we will be doing in our study. Such studies measured HR for athletic purposes, opposed to cognitive objectives. Our present study will use up-to-date fitness tracking devices, opposed to the previous studies which used devices from years ago. A previous study (Goodie, Larkin, & Schauss, 2000) tested the validity by taking one data point in the form of an average representing the mean HR of that task. In our study, we will be taking 10 data points, each representing the average of a minute. This allows us to look at precise physiological changes in the cognitive tasks.

METHODS: Using a 3x2 repeated measures design we plan to recruit 40 participants through SONA and Life at UCF. There will be 20 young participants (ages 18-25), and 20 older participants (ages 60-90). Older subjects will be recruited due to the differences we expect to see in the usability of the devices, such as differences in skin elasticity. The subjects will be simultaneously equipped to both the Basis Peak and Microsoft Band (fitness-tracking devices), and ECG. Participants will be provided fitness tracking devices for the study. Baseline physiological data will be recorded during a 10 minute interval while the participants are at rest. The participants will then be given a familiar and easy cognitive task (sorting out playing cards), to provide data about cognitive functioning when demands are low (Falduto & Baron, 1986). They will then be given a 10-minute difficult cognitive task known as the N-back Task (Kane, Conway, Miura, & Cofflesh, 2007). The N-back task is a working memory test that requires participants to recall a stimulus that was presented n times back. For the present study we will randomize the conditions as either using a 1-back task (easy condition) or a 3-back task (hard condition). Following the task, participants will be given a 10 minute break to return back to their resting state; participants would then again repeat the task. Each device will be recording HR/GSR throughout the study. The fitness devices will track a running average of HR/GSR over a minute, whereas the physiological hardware will provide us with 500 samples/second.
EXPECTED OUTCOME: The ECG data will be analyzed to detect the presence of stress and workload during the cognitive tasks, and differences between the at-rest baseline and during the task will be calculated using data-points/second. Data from the fitness tracking devices will be analyzed in the same way, and the running average processing between baseline and task will be statistically compared (using ANOVA) across all devices. We expect that the fitness tracking devices will record running ratios equivalent to that of the ECG, which would validate them as appropriate tools for measuring stress and workload in cognitive research settings. We expect to see a slight difference in physiological data between younger and older adults due to skin elasticity. Overall, we believe these fitness tracking devices will be a valid method for purposes noted, especially in field research and other environments where it would be inefficient to use more complicated physiological devices.

TIMELINE/PLAN OF WORK:

January 2016
- Complete preparation of experimental materials and software.
- Begin bringing in young SONA participants into the lab to take part in the experiment.

February 2016
- With participants being brought into the lab each week, data collection for younger participants will be completed.

March 2016
- Begin coding and analysis of the experiment data for younger participants.
- Finish coding and analysis of the data for younger participants.
- Attend Office of Undergraduate Research workshop on preparing data for poster presentations, and finish the creation of a poster

April 2016
- Present findings at the Showcase of Undergraduate Research (SURE).
- Begin bringing in older LIFE participants into the lab to take part in the experiment.

May 2016 - August 2016
- Continue bringing in older LIFE participants into the lab; data collection will be completed during this time.

September 2016
- Begin coding and analysis of the experiment for older participants.
- Finish coding and analysis of the experiment for older participants.

October 2016
- Begin to write a summation of my data for the UCF Undergraduate Research Journal or other professional journal.

December 2016
- Publish my findings to the UCF Undergraduate Research Journal or other professional journal.
ITEMIZED BUDGET AND BUDGET JUSTIFICATION:

<table>
<thead>
<tr>
<th>Item</th>
<th>Justification</th>
<th>Quantity</th>
<th>Cost</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopac Nuprep Gel</td>
<td>These ECG physiological prep materials will need to be purchased to ensure the data is being collected properly and reliably. Because these items are disposable we need to purchase enough to run all participants.</td>
<td>1</td>
<td>$24.00</td>
<td>$24.00</td>
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<tr>
<td>Biopac Amplifying Gel</td>
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<tr>
<td>Biopac ECG Sensors</td>
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<td>Biopac GSR Sensors</td>
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<td>$45.00</td>
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<td>Kendall Healthcare Standard Porous Medical Tape</td>
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<tr>
<td>Microsoft Band Smart Watch with Heart Rate Monitor</td>
<td>Although we have ECG, we do not have enough consumer-fitness tracking devices which will be crucial for physiological measures throughout this research study.</td>
<td>2</td>
<td>$138.44</td>
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<tr>
<td>Basis Peak Fitness and Sleep Tracker + Heart Rate Monitor</td>
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<td>2</td>
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<td>$425.98</td>
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<tr>
<td>NETGEAR WiFi USB 2.0 Adapter</td>
<td>To connect the computer to the internet for this research study.</td>
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<td>Bicycle Eco</td>
<td>Required for the low demand task during this research study.</td>
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Total Requested $906.86