# The Usability of a Heartbeat Measuring Mobile Phone app: an Observational Study

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## Introduction

Mobile applications (Apps) for tablets and smartphones are changing how health care is provided to patients [1]. The use of Apps is proving especially useful in nursing practice [2, 3] and the various medical professions [4, 5]. There are downloadable Apps for cellular phones that can simply and painlessly measure heart rate [6], including the App Heart Rate Plus, which was validated by Losa et al. in 2014 [7]. The Heart Rate Plus App has high reliability and consistency in the measures offered. This reliability combined with its low cost makes it a valid instrument for measuring the heart rate in a healthy population [7]. Therefore, using a validated questionnaire of usability, the objective of this research was to demonstrate that the App Heart Rate Plus is an easy, understandable, and attractive App for use by the general population and nurses. We hypothesized that App Heart Rate Plus is an easy, understandable, and attractive App for use by the general population and nurses.

## Methods

We perform an observational study of non-probability consecutive sampling with two study groups: one of healthy volunteers (GROUP NON-NURSES) from a university population and another of register nurses (GROUP NURSES). The study was conducted between January 2014 to February 2014; all of the participants had experience with Apps for more than 5 years. We follow the STROBE guidelines for observational studies.

The groups were trained how to take pulses through the App, and also they completed a questionnaire of usability criteria for the Heart Rate Plus App (https://play.google.com/store/ apps / details? id = com.dungelin.heartrate) [8] for the Smartphone Samsung Galaxy Note. This mobile application measures the heart rate using the sensor and flash camera phone, processing images of the blood of the index finger, which must be placed on the camera for between 10 and 30 s.

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The study included 80 adult healthy volunteers (40 nurses and 40 non-nurses). Socio-demographic data were collected, and the volunteers measured their pulse five times using the App for Galaxy Galaxy Note cell phone (chosen because of its low cost and liquid crystal display for measuring the pulse).

In the questionnaire, usability parameters were set according to the criteria of Ferré-Grau 2001 [9] and Obeso-Alva 2005 [10], considering usability criteria as Learnability; Memorability, Understandability, and Attractiveness (Table 1). Also, the criteria of Hix and Hartson [11] and Wixon and Wilson [12] were followed for a heuristic evaluation, being encoded as HIGH, MEDIUM or LOW.

Exclusion criteria were: diagnosis of cardiac pathologies or abnormalities, high body temperature, alterations in the digital area (cuts, blisters, scars, etc.), cold finger or hands.

Statistical analyses were performed using descriptive recounts and percentages for qualitative variables and mean and deviations for quantitative variables. For the analysis of the statistical association between variables, we used a parametric chi-square with a statistical significance level of ≤0.05. SPSS v.20 was used for all analyses.

This study was approved by the Ethics Committee, and all participants signed informed consent for participation in this study.

## Results

### Sample description

From the initial sample of 80 healthy individuals (40 non-nurses and 40 nurses), more than half (62.5%) were women and the rest men, with a mean age of $39.7 \pm 7.1$ years (range, 27–53 years). Most of the sample considered the App as highly learnable (85%), highly memorable (92.5%), and highly understandable and attractive (87.5%).

The NON-NURSES GROUP was composed of 22 men and 18 women, with a mean age of $39.5 \pm 6.9$ (range 27–52 years). The NURSES GROUP was composed of 40 nurses,

**Table 1**    Parameters of usability for software applications

1. Learnability: Determines how much the user understands how to initially use the tool and how quickly they achieve a maximum level of knowledge and use.

2. Memorability: For intermittent users (who do not use the system regularly). When users return to the design after a period of not using it, how easily can they re-establish proficiency?

3. Understandability: If new users can understand it, is the software suitable or how can it be used for particular tasks.

4. Attractive: One of the main features of the software products is its aesthetic appearance or visual attraction, which should be visually appealing. The combination of text, graphics, and colors used should help the user to understand the content.

of which 34 were women and 8 men, with a mean age of $40.3 \pm 7.5$ (range 29–53 years).

Most of the total sample considered the App to be learnable (85%), understandable (87.5%), and attractive (87.5%). Amon the NON-NURSES, 85% considered the App easy to use, 90% considered it memorable, 80% understandable, and 85% attractive. Among NURSES, 85% considered it learnable, 95% memorable, 95% understandable and 90% attractive.

### Chi-square analysis for variables usability criteria and group, sex, and age

The chi-square analysis regarding the association of the variable GROUP NON-NURSE OR NURSE found no significant association between the variables (Learnability, Memorability, Understandability, or Attractiveness).

We detected significant associations between the variables Sex and Learnability ($p = 0.044$) and Sex and Understandability ($p = 0.05$) (Table 2).

Analyzing the variable AGE codified into two categories (up to 39 years and 30 years or more), we found statistically significant associations between AGE and Learnability and Memorability and Understandability (both $p = 0.05$) (Table 2).

## Discussion

The main objective of this study was to check if the App met basic usability criteria and if the results can confirm that the App is easy to use, memorable, understandable, and attractive.

Our sample is above 39 years old, with university studies and experience in Apps use, in which generally the four principles of usability shown with high levels of learnability, memorability, understandability and attractive. In this case, we follow the recommendations of Bolaños-Pizarro et al. [13], who advise that usability studies should be conducted with specific focus groups. We found that the App Heart Rate Plus can be used by the general population and health care providers.

We consider our sample to be representative; most App usability studies include less than 40 users. Also, Nielsen [14, 15] recommends that five users are enough to test an App, who are likely to identify about 80% of the usability problems [16].

When comparing the nurses' and non-nurses' usability data for the Heart Rate App between, we founded similar results. No usability parameter in any group was lower than 85%, thus confirming the high learnability, memorability, understandability, and attractive of the App. Other Apps have reported similar usability results, such as Zargaran et al. in 2014 [17], who analyzed an application for Trauma Care, or Al Ayubi [18], who reported results of high satisfaction and high standards of usability with an application for physical activity. Our data are better than those recently offered Turner et al., which concluded that applications for the prevention and treatment

**Table 2** Responses of the 80 participants to the statements on usability

| Statement | | LOW | MEDIUM | HIGH | P Value* Group |
|---|---|---|---|---|---|
| 1. Learnability | | | | | 0.301 |
| | NON-NURSE | 5.0 | 10.0 | 85.0 | |
| | NURSE | 0 | 15.0 | 85.0 | |
| 2. Memorability | | 0 | 10.0 | 90.0 | 0.338 |
| | | 0 | 5.0 | 95.0 | |
| 3. Understandability | | 5.0 | 15.0 | 80.0 | **0.044** |
| | | 0 | 15.0 | 85.0 | |
| 4. Attractive | | 0 | 15.0 | 85.0 | 0.369 |
| | | 0 | 10.0 | 90.0 | |
| Statement | | LOW | MEDIUM | HIGH | P Value* Sex |
| 1. Learnability | | | | | |
| | FEMALE | 6.7 | 20.0 | 73.3 | |
| | MALE | 0 | 8.0 | 92.0 | **0.044** |
| 2. Memorability | | 0 | 13.3 | 86.7 | 0.137 |
| | | 0 | 4.0 | 96.0 | |
| 3. Understandability | | 0 | 26.7 | 73.3 | **0.005** |
| | | 0 | 4.0 | 96.0 | |
| 4. Attractive | | 0 | 13.3 | 86.7 | 0.560 |
| | | 0 | 12.0 | 88.0 | |
| Statement | | LOW | MEDIUM | HIGH | P Value* Age |
| 1. Learnability | | | | | |
| | UP to 39 | 0 | 0 | 100.0 | |
| | 39 or MORE | 5.3 | 5.3 | 68.4 | **0.000** |
| 2. Memorability | | 0 | 0 | 100.0 | **0.009** |
| | | 0 | 15.8 | 84.2 | |
| 3. Understandability | | 0 | 4.8 | 95.2 | **0.030** |
| | | 0 | 21.1 | 78.9 | |
| 4. Attractive | | 0 | 9.5 | 90.5 | |
| | | 0 | 15.8 | 84.2 | 0.306 |

Bold means that the value is signiticative

Data are given as percentages

*P values are from χ2 tests of cross-tabulations between the categorical variables and the response variables, where the category levels with large differences between observed and expected frequencies are indicated

of childhood obesity are of moderate-to-high usability, feasibility, and acceptability [19].

The women participants reported higher learnability and understandability values than the men. Other authors have reported that women learn faster than men [20]. Also, there is evidence of gender differences in the use of the Internet and new technologies. For example, Eric Weiser [21] showed that males use the Internet mainly for purposes related to entertainment and leisure, whereas women use it for interpersonal communication and educational assistance. Regarding learning and usage patterns, we detected no major differences between the sexes. Another study that analyzed the usability of video game consoles for clinical game-based motor rehabilitation also found no differences between the sexes [22]. Also, other studies have suggested that educational level is the major factor influencing middle-aged learners' use of computer interfaces, while gender is a relatively insignificant factor [23], and

that the demographic factors of gender, education background, and work nature did not have a significant influence on Apps usability [24].

In our sample, younger people were more learnability, memorability, and understandability. A recent study by Erika Olmsted-Hawala (2015) have revealed age-related differences in the usability, accuracy, efficiency, and user satisfaction using smartphones; older adults were less accurate and took longer to complete tasks [25]. Young people typically have a greater facility for learning and understandability Apps because they belong to the Millennial age group, who tend to be highly versed in technology [26].

Our study has some limitations and bias. First, our population has a high cultural level; all have a university degree, and hence we not able to generalize the data to a population with lower education. Also, our sample is healthy (e.g., without cardio-vascular diseases), and would be interesting to conduct

a study including patients with specific health conditions that might benefit from good heartbeat control. The sampling bias is given by the study design.

## Conclusion

In a university population, we demonstrate that the Heart Rate Plus App, is an easy, memorable, understandable, and attractive application, and that there are no differences in the usability parameters when comparing the general population and nurses.

## Compliance with ethical standards

**Conflict of interest**    No potential conflict of interest was reported by the authors.

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