Assessing the User Experience Design as a Persuasive Methodology in a Real World Sport Application

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ABSTRACT

In the last years, researchers are experimenting with innovative methodologies to help people in their daily training routines. Our research activity focuses on the study of the effects of the former technologies on people's sport habits. This work describes an experimentation conducted on *Everywhere Run!* (EWRun), a mobile application part of a bigger platform, that aims at helping people to stay active behaving like a virtual personal trainer. In this work we show some interesting results that arise from recent radical changes we made to the software usability and its graphical design. We observed a considerable increment of the user base and, as a consequence, of the total number of daily trainings. To statistically prove the effectiveness of the redesign, we decided to compare the two versions of the application. The results confirm its effectiveness in terms of usability and brought us to investigate how the new design is affecting user motivation by means of a custom questionnaire and a well known motivation assessment tool. The positive result observed will be the starting point of our forthcoming researches: we aim at further validating the results presented in this work over a longer period of time and over a larger number of real users.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces—*Evaluation/methodology, Style guides*;
J.3 [**Computer Applications**]: Life and Medical Sciences—*health*

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General Terms

Human Computer Interaction, User Experience Design, Persuasive Technology, Sport, Motivation, Healthy Lifestyle

1. INTRODUCTION

A regular physical exercise has been demonstrated to be essential for people well-being (see, for example, [35], [29], [34] and [20]). The lack of exercise can be the cause, for example, of lower life expectancy, chronic diseases and many other health problems. Pros and cons of a healthy lifestyle are well known, nevertheless, as former studies put in evidence, it does not seem to be enough to motivate people to conduct a healthier lifestyle. This phenomenon is clearly shown by several researches as, for example, by the report of the World Health Organization (WHO) for the two-years period 2008-2010 [27].

The report, along with other similar studies (see for example [28]), lists some recommendations for a better lifestyle. Here we report some suggested advices:

- Limit the intake of free sugars
- Limit salt (sodium) consumption from all sources and ensure that salt is iodized
- Engage in regular physical activity
- Limit energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats and towards the elimination of trans-fatty acids
- Increase consumption of fruits, vegetables, legumes, whole grains and nuts

Many researchers from different fields, sport related companies and sometimes small-and medium-sized software houses are proposing new persuasive methods and tools to help individuals in everyday physical activities. In most of the cases, these methodologies tend to leverage a fun oriented approach together with new mobile technologies to foster people towards healthy habits. Buttussi et al. in [15] propose a three-way classification for this kind of persuasive tools:

- Computer-supported physical games
- Virtual trainers
- Mobile applications and devices

We decided to focus our efforts on the last category since it seems to be the most promising one both in terms of the high number of related researches and proposed solutions. Mobile technologies are becoming more and more widespread and are somehow affecting people's everyday life. New generation devices are relatively inexpensive, versatile, highly portable and are potentially usable at anytime, anywhere. As an example, in [25] we proposed a mobile application, called *Everywhere Race!*, that allows users from all over the world to interact and to compete in virtual real time races in different speed-based sports. *Everywhere Run!*, as well as *Everywhere Race!*, fosters social interactions. However, its interaction model (EWRun) is different from other similar applications. It focuses on relationships between users and real personal trainers in addition to that, more common, between similar users. In this way, it is quite straightforward for beginner runners to get a tailored workout plan and to start running avoiding common first-time mistakes. A user can request a customized training plan to a real trainer and he can receive it seamlessly inside *Everywhere Run!*. At this point the user as just to start running letting himself be guided by the virtual trainer to run the selected distance at the right pace.

Several studies (see for example [13] and [32]) show the importance and the influence of social interactions in sport. The constant support of a qualified trainer, in addition to make workouts safer, is much more motivating in the long term too. EWRun is designed to help people to get rid of some common deterrents to physical activity like, for example, time constraints and gym membership fees. The application allows users to get in touch with a real trainer to obtain a tailored workout plan they can follow at anytime, anywhere. This results both in more time flexibility and in lower costs for users given that it is not mandatory for them to meet with a real coach.

Some available solutions try to attract users focusing mainly on people performance rather than the social and ludic aspects of sport. In some cases this can be a limiting factor especially when the aim is both to attract non-habitual sportsmen and to motivate them in the long term. With respect to other proposals, our approach promotes interactions between users and real trainers through a community of runners. Very preliminary results confirm that users appreciate EWRun functionalities ([24]), meaning that our work is on the good track. Nevertheless, recent application usage statistics suggest that a great feature set, although innovative, is not enough if the whole design has not been realized with a special attention to user experience. Our assertion, as previously stated in the "Abstract" section, follows from recent radical changes we made to the application design. We followed standard usability guidelines and some Android design recommendations [2] to drastically redesign the whole application look&feel. As a result, we observed a remarkable application user base growth even if there were no notable functional improvements. As a consequence, we decided to statistically prove the goodness of the new design with respect to the old one. We conduct an A/B test on 40 users through two standard System Usability Scale (SUS) questionnaires [14] (one questionnaire for each design under evaluation [6]).
Moreover, we started investigating the impact of the user experience design on user motivation. We obtained encouraging preliminary results thanks to a sample of 30 beta tester users that responded to a custom questionnaire and to a well known motivation assessment tool.

The good results obtained so far suggest us that the offered functionalities without the right design are not enough to attract and to motivate people especially for a long time period. To the best of our knowledge we are the first, in the field of mobile persuasive technologies, to show similar results for a real world application used by hundreds of users everyday. This interesting results bring us to another intuition that we will further investigate in the near future: user experience can alter individual motivation and can deeply influence their perception of the offered functionalities.
The rest of this paper is organized as follows: Section 2 surveys the state of the art in the field of persuasive computing. Section 3 briefly describes the application and shows how its design has been changed, whereas Section 4 reports the experimentation results. Section 5 concludes the paper.

2. RELATED WORK

This section reports some studies and some technological systems designed to help people during daily physical activities.

In [25] authors propose *Everywhere Race!*, an innovative mobile Android application designed to motivate people in a wide range of speed-based sport activities. It allows users from all over the world to compete against each other in different speed-based sports. The application, in a completely different way than others, allows real time virtual races among participants and makes available a significant set of social functionalities by means of the social network Facebook.

IJsselsteijn et al. [22] investigate on intrinsic motivations enhancement. For their experiments, they realized a virtual coach system to help users while cycling on a stationary bike. They observed a good users reaction to the stimuli provided by the coach and derived some important results about the way the users perceived the information provided by the virtual trainer during the training sessions.

In [12] is presented Your Shape Fitness Evolved, a fitness game for Microsoft Kinect. The system is designed to help users during indoor workouts. The application, among other features, allows users to design a custom workout, to keep track of training statistics and to challenge other users by means of a virtual community.

Toscos et al. [33] propose an application to help teenage girls to adopt a healthy lifestyle. The application, called Chick Clique, stores information about the caloric content of popular foods and the amount of steps necessary to burn them. Chick Clique aims at fostering social interactions by means of SMS in order to boost a friendly competition among users.

In [21] are illustrated the results regarding the experimentation of a famous dance video game called Dance Dance Revolution. The results stress the positive influence of gaming with respect to motivational, physical and social factors.

In [16] authors propose a location-based exergame based on the classic Snake mobile game in which the snake is driven by user movements. The aim of the work is twofold: firstly,

it encourages users to walk in a fun way and secondly, it demonstrates the effectiveness of the solution through the adoption of standard questionnaires used in medical field. Obtained results demonstrate how user behavior can be influenced by the fun resulting from the game.

Oliveira et al. [19] presented a mobile phone application called TripleBeat. The application uses both an accelerometer and an ECG to push runners to achieve predefined goals expressed in terms of heart rates. Their experimentation revealed the importance of a well-designed graphical user interface in order to enforce user motivations.

In [17] is presented a Symbian OS based application called Houston. The application makes use of a pedometer to count user steps, then it records and shares its results. The authors derived some interesting key design requirements to be used in this class of mobile applications:

- Users expect to have thorough measures and long term statistical reports of their activities
- Support for social features to improve user motivation through a friendly competition
- Take into account the comfort of proposed solutions

Consolovo et al., in [18], present UbiFit Garden, a mobile system that uses on-body sensing, activity inference and mobile display to encourage people to stay active. Preliminary results derived from a three-week field trial show that users were positively surprised by the novelties introduced by the application and their responses help authors to derive some guidelines to be observed to improve their system.

Nike+ [26] is one of the most popular iOS applications to help people during sport activities. Some of its main strengths are: the advanced vocal cues and music system management, the deep use of social networks and the support of a web community where users can create their workouts plans and interact with other sportsmen.

Along with Nike+ there exist several other commercial examples of such a kind of applications. Just to name a few (see Section "References" for websites): Runtastic, Endomondo, RunKeeper, MapMyFitness, Adidas miCoach and many others. All these systems provide more or less the same core functionalities:

- Route and workout data tracking
- Statistical reports
- Results sharing through ad hoc communities or social networks

The work presented in this paper, as previously stated, is focused on the study of the effects of user experience in the field of persuasive technologies. Through the following sections we are going to describe how EWRun has been redesigned, the procedure we used to evaluate both the new and old application versions and the obtained results. From our researches on this topic, we have not found similar case studies. This is probably because academic proposals are typically prototypes and do not have a considerable amount of users to conduct comprehensive tests. Commercial products, on the contrary, usually have a huge amount of users and refined designs but, to the best of our knowledge, there are no publicly available experimental results about them.

Figure 1: Application dashboard.

3. EVERYWHERE RUN! REDESIGN

EverywhereRun! [24] is a mobile application (currently available for the Android platform) designed to support people during their training routines. It allows users to design their own regimes or, in a completely innovative way, to get tailored ones from a real personal trainer, seamlessly inside the application. Inspired also by the design guidelines proposed by [17], we introduced a new home screen (see Figure 1) that reports the aggregate statistics of user's trainings such as: the total run distance, the total workout number, the average speeds and so on.

Figure 2 and Figure 3 show the workout creation screen, respectively for the old and the new design. Through this menu it is possible to plan relatively complex regimes like the one, called "Monday", showed in the two figures: the training is composed of several "sessions", called "traits", defined in terms of distance and pace (or speed) to keep. For example, trait 1 (see Figure 2 or Figure 3) means the user wants to run 2km at a pace of 5 minutes per kilometer (note: runners generally express speed as the time to run one kilometer or mile). Trait 1 is followed by trait 2 where the runner expects to run 10km at a higher pace than before (4 minutes and 20 seconds per kilometer). Hence EWRun permits to define quite complex regimes in order to satisfy even the most demanding runners. Both designs offer the same features in terms of training creation, although the new one is very different in terms of usability (note that the following considerations hold for all the new design screens): global application settings have been made available in this screen whereas many other options, local to the screen, have been moved from the bottom of the screen to the topmost bar (in part inspired by the new Android design guidelines). In this manner, the navigation among screens is more homogeneous and much better organized. Indeed, many locally available functionalities are grouped in the top bar rather than scattered all over the screen.

As already emphasized, the most important EWRun feature is the virtual personal trainer. Thanks to this functionality, the application is able both to guide and to encourage the runner during the whole workout in order for him to reach predefined goals (i.e., the goals set by means of the workout creation screen, see Figure 2 or Figure 3). This is achieved both through real time audio cues and by means of an intuitive interface where the user can get all needed information at a glance, while running. In Figure 4 and Figure 5 it is possible to observe, again for the old and the new design, the ongoing workout screen and how the virtual personal trainer feature works.

Figure 4 (note, again, that the features are the same in

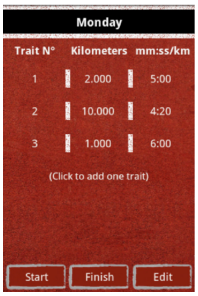

Figure 2: Workout creation menu: old design.

Figure 3: Workout creation menu: new design.

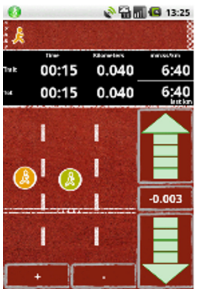

Figure 4: Personal trainer screen: old design.

Figure 5: Personal trainer screen: new design.

both cases) shows the virtual trainer represented by the orange icon in the left center of the screen. He has the role of a pacemaker (note: a pacemaker is a runner that leads the race to keep the pace for other runners) so that the user (virtually represented by the green icon in the center of the screen) has just to follow him focusing only on the run. In both designs, the topmost part of the screen contains a horizontal bar to give user an overview of the whole workout (note that the workout length is known a priori since it has been defined in the workout creation screen) with the actual position of the runner with respect to the virtual trainer. Just below that bar there is a dashboard that reports current speeds, distances and times regarding both the current trait and the whole training session. The two buttons in the bottommost of the screen (only for the old releases) allow to zoom in/out the part of the whole workout depicted in the central part of the screen. This was supposed to make it easier for the user to estimate the current distance to the trainer (see below).

In the old design, the two big arrows in the right side of the screen suggested to the user if he has to slow down or to speed up. In between the arrows the current distance of the runner to the trainer is clearly indicated. Furthermore, the arrows will be alternatively filled proportionally to the need of slowing down or speeding up. Hence, with just a quick glance at the screen, the user knows his current performance level, at any moment in time. All that can be observed in Figure 4. It depicts a runner just 3 meters behind the virtual coach, thus none of the arrows is filled to signal that the user is keeping the proper pace.

Now, we are going to further explore the differences between the two designs: in addition to the aforementioned bar at the topmost of the screen (see Figure 5), used both to improve the navigability and to more evenly group global and local options, we focused our efforts to redesign the portion of the screen that depicts the user and the virtual coach during a training session (i.e., the "personal trainer" area in the lower half of Figure 5). We decided, thanks also to some advices from EWRun beta testers, to simplify the various components originally present. At first, in addition to a general graphic improvement, we switched the "personal trainer" area from a vertical to a horizontal orientation to be consistent with the whole workout perspective at the topmost of the screen. Secondly, the zoom in/out buttons have been removed since they seem to cause some troubles when used during a training and finally, we removed one of the two arrows. Indeed, now there is only one arrow that changes its orientation accordingly to the user current position (w.r.t. the virtual personal trainer). The distance gap between the user and the trainer is now near the icon representing the user, in its left. In this way, we keep user data as compact as possible, also decreasing the total number of shown elements, for an improved readability.

4. EXPERIMENTAL RESULTS

As previously described in Section 3, the new design of *Everywhere Run!* caused a statistically significant user base growth. As a result, we decided to compare the two designs by means of a standard testing methodology known as A/B testing [31]. Let us start by describing the application usage statistics that inspired us to conduct this study and, afterwards, we will describe in more detail the above technique and the mathematical tools we used for the experimentation.

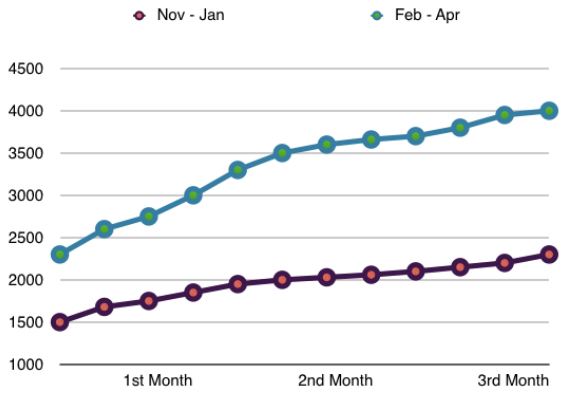

Figure 6: Number of trainings with old (Nov 2012. to Jan 2013) and new design (Feb. to Apr. 2013).

Figure 6 shows the number of weekly workouts (by all users) performed with the old and the new application design. The data have been collected over a three months period, from November 2012 to January 2013 for the old design and from February to April 2013 for the new design.

The graphic shows the number of trainings passing from about 1500 of the 1st of November 2012 to about 2300 (+53%) at the end of January 2013. In general, there is a positive growth rate but much lower when compared to usage statistics for the next three months. With the introduction of the new graphic design in February 2013 (again there were no new features offered) the number of trainings passed from about 2300 to about 4000 (+74%).

Now we are going to explain the A/B test we conducted. A/B testing, also known as split testing, is a widely adopted technique typically used to compare two design variants (A and B) of the same system. Amazon was probably the first industrial entity to adopt this procedure to evaluate the user experience of its marketplace. Differences between version A and version B can range from completely different layouts to, for example, the font type, the different disposition of a button and so on. The goal of the evaluation is to identify some changes that can increase a certain metric of interest. The test has been conducted using the System Usability Scale (SUS) questionnaire [14]. SUS is a well known tool (it counts more than 600 citations [30]) used both by industries and by academics. SUS is technology independent and it has been used to test web sites, hardware, consumer software and much more. It is composed of 10 questions with 5 response options. Each question is rated using a Likert scale ranging from 0 ("strongly disagree") to 5 ("strongly agree"). We conducted our experiment with a sample of 40 users that used both application versions. The sample was composed of 34 males and 6 females with an average age of 35.8 years (standard deviation was 10.4 years). All the users regularly practiced sport at an amateur level and they all have had at least a previous experience with applications to support physical activity. Table 1 reports the results obtained by the SUS questionnaire.

Table 1: SUS Mean Scores.

	New	Old	Difference
Mean	**86.3**	**59.5**	**26.8**

For our experimentation we adopted the method proposed by Sauro et al. [31] to prove what the statistics suggest (see Figure 6). Often, in many research fields (HCI is no exception), the population mean and standard deviation are not known so it is not possible to use the Empirical Rule and z-scores (see [36] and [31])). Under those circumstances it is used a paired t-test (see [38]) to compare how a limited number of testers perform in two different test conditions. In particular, a paired t-test will allow us to determine if the difference between SUS score means for the two designs is significant or not. To calculate the test statistic t, the following formula is used:

$$t = \frac{D}{\frac{S_d}{\sqrt{n}}} \tag{1}$$

In this formula, D is the mean of the difference scores, S_d is the standard deviation of the difference scores and n is the sample size. In our case (see Table 1) D is equal to 26.8, S_d is equal to 15.621 and the sample size (n) is 40. From the Formula 1 we obtain a value for t equal to 18.85. Is this value statistically significant? To answer this question we have to look up the p-value [37] using the *Student's* distribution table with n-1 (39) degrees of freedom. The table give us 2.415×10^{-13}. This very small value tell us that the SUS scores for the two designs is different with a probability very close to 100%. This result confirms us that the difference is statistically significant but, is it significant enough for users so that they will notice it? The confidence interval around the difference will answer to this question. The formula 2 is used to determine the confidence interval.

$$D \pm t_\alpha \frac{S_d}{\sqrt{n}} \tag{2}$$

where: D is the mean of the difference scores, n is the sample size, S_d is the standard deviation of the difference scores and t_α is the critical value for n-1 degrees of freedom. For a 95% confidence interval and 39 degrees of freedom t_α is equal to 2.07. Plugging in all the values in Formula 2 we get 26.8±5.006. In other words we can be 95% confident the actual difference of scores is between 21.8 and 31.8. These results confirm our initial intuition and demonstrate that the new design usability is better both statistically and in terms of user perception.

To further investigate if the new design was positively influencing user motivation, we conducted a preliminary custom survey over a sample of 30 beta tester users. The sample was composed of 24 males and 6 females with an average age of 34.9 years and standard deviation equal to 9.2. All testers used both the versions of the application for at least 6 months and they all exercised regularly at least one time per week. We asked them to report how many times per week they generally exercised both with the old and new version of the application. The results are shown in Table 2.

Table 2 reports that the average number of trainings per week is 2.10 for the old design (standard deviation 1.09) and 2.77 for the new design (standard deviation 1.13). Thus users exercised, on average, about 32% more often with the new application version. These data seem to support our intuition even if they are referred to a short period of time (indeed assessing user motivation would need years rather than months). In order to further validate these preliminary encouraging results, we decided to conduct another

Table 2: Exercise frequency per week.

User	Old Design	New Design	Difference
1	1	2	1
2	1	1	0
3	1	3	2
4	2	2	0
5	1	3	2
6	2	4	2
7	3	3	0
8	1	1	0
9	2	3	1
10	3	2	-1
11	2	2	0
12	5	5	0
13	2	4	2
14	1	1	0
15	2	4	2
16	4	4	0
17	3	4	1
18	1	1	0
19	4	4	0
20	3	4	1
21	1	3	2
22	2	1	-1
23	1	2	1
24	3	3	0
25	3	3	0
26	1	3	2
27	2	2	0
28	1	3	2
29	2	2	0
30	3	4	1
Mean	**2.10**	**2.77**	**0.67**

evaluation on the same group of 30 beta testers presented above. Always with the intent to figure out whether and how user motivation has been affected by the redesign, we used the Exercise Motivations Inventory - 2 (EMI-2) [23]. It is a questionnaire composed of 51 items subdivided into 14 scales. Each item is rated using a Likert scale ranging from 0 (which means "not at all true for me") to 5 (which means "very true for me"). Users where asked to compile one questionnaire for the new version and another for the old version. The graph depicted in Figure 7 reports, for the new design, the mean values obtained for each scale. As it is possible to see, all the scales received good average scores (3.8 out of 5 is the lowest value) with a total average score of 4.2 out of 5 (for the new version). The old version (the detailed results are not shown) scored 3.9 out of 5 (note, again, that the two versions do not differ in terms of offered features). These results confirm once again our initial intuition.

In conclusion, although a stronger and reliable evaluation would require years instead of months and many more testers, we can be rather confident that our case study shed new light on how a good user experience design can be a critical factor for the engagement and motivation of users.

5. CONCLUSION AND FUTURE WORK

Many studies and solutions have been proposed to limit

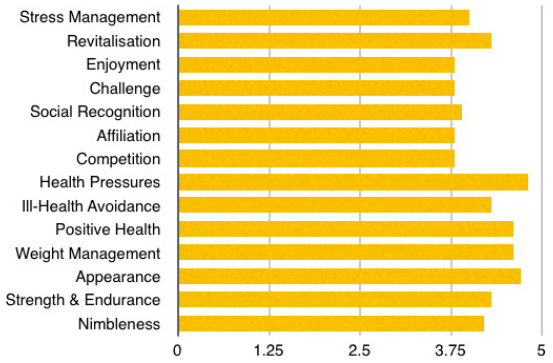

Figure 7: EMI-2 results for the new design.

the increase of health diseases that, in most cases, are related to a sedentary lifestyle. In this work we presented the results of two experimentations we conducted on a total of 70 real users of *Everywhere Run!*. The application aims at guiding runners during their training routines giving them the possibility to plan quite complex regimes on their own, or to get a completely tailored one from a real trainer by means of the application. EWRun implements a new interaction model allowing users to communicate directly with real personal trainers in order to get a tailored workout plan. Once the user has his own workout, he has just to start the training and the application will guide him by means of the "virtual personal trainer" feature. As proven by previously conducted tests (see [24]), users well appreciate the application features. Recent radical changes we made to the application design and the related user reaction, led us to consider not only the implementation of new functionalities but also to keep into great account the user experience design. We observed a remarkable user base growth even if the application offers more or less the same features offered in the past. As a consequence, we decided to compare the two designs. We conducted a test on 40 real users by means of a standard and well known methodology which uses a SUS questionnaire. Moreover, to investigate the relationship between user experience design and motivation, we conducted a preliminary study on 30 real users by means of a custom questionnaire and a well known motivation assessment tool. The encouraging results obtained so far confirmed our intuition: innovative features may not be enough to motivate users if the user experience is not taken into great account. To the best of our knowledge we are the first, in the field of mobile persuasive technologies, to show similar results for a real world application used by hundreds of users everyday. Our future research activity will aim at further investigating the correlation between user experience and user motivation over a longer period of time, starting from the preliminary encouraging results obtained in this work.

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