Race By Hearts

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Using Technology to Facilitate Enjoyable and Social Workouts

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Abstract. In this paper, we explore the qualities of sharing biometric data in real-time between athletes, in order to increase two motivational factors for gym-goers: Enjoyment and social interaction. We present a novel smartphone application, called Race By Hearts, which enables competition based on heart rate data sharing between users in real-time. Through an empirical study conducted in the gym, we show that sharing biometric data in real-time can strengthen social relations between participants, increase motivation, and improve the enjoyment of the fitness activity. Nevertheless, we found that introducing competition based on real-time sharing of biometric data can cause exasperation and discouragement for some athletes. Based on our findings from the study, we discuss how technology can facilitate and modify competition in fitness exercises in general.

Keywords. Exertion interfaces, interactive sport-training systems, biometric feedback, heart rate, wearable computing.

1 Introduction

Convincing oneself to go to the gym can be a hard task. Often people join the gym as a result of a sudden realization that the state of their physical condition was not in alignment with their self-image [2]. However, in the U.S. 67 % of people with a gym membership never use it [11], as they fail to make workouts part of their everyday life due to motivation deficiency. According to Crossley [2], regular gym-goers have a vocabulary of motives that continuously drives them to the gym, including enjoyment and social interaction. This paper seeks to utilize these two motivational factors, as a way to make regular indoor cycling classes more appealing, by enabling indoor cyclists to share biometric data with other cyclists in real-time.

The emergence of smartphone devices and compatible heart rate belts has enabled sports practitioners to measure and share biometric data via sharing networks, such as Runkeeper or Endomondo. The effects of real-time broadcasting of biometric data to social networks have shown to create a stronger tie between practitioners and their friends on social networks as well as to motivate practitioners during sports activities [3]. However, the social and competitive effects of gym-goers interacting through biometric data in real-time have not previously been investigated.

In this paper, we investigate the effects of introducing technology that facilitates a social interaction through real-time sharing of biometric data in an indoor gym context, thereby enabling competition in an otherwise non-competitive sport setting. We report on a study with 20 indoor cyclists, who were equipped with a smartphone running an application, called Race By Hearts (RBH), that enables interaction between cyclists by dynamically displaying and sharing heart rate (HR) data in real-time.

The results from our studies showed that sharing biometric data facilitates a social relation, motivates indoor cyclists to increase their effort, and improves the enjoyment of the fitness activity. Furthermore, we identified important challenges in terms of exasperation and discouragement, which can occur when introducing a competitive element in an exercise situation. Finally, we discuss how technology can facilitate different kinds of competition in non-competitive sports and change the original opponent format.

1.1 Indoor Cycling

Indoor cycling, also often referred to as spinning, is a high-intensity exercise where indoor cyclists use stationary bikes with adjustable resistance to follow the music and verbal instruction given by an indoor cycling instructor. The instructor instructs the indoor cyclists to adjust the resistance, the riding style (sitting / standing), and the cadence during class. Often the stationary bikes are placed in a half-moon cycle so that the cyclists face the indoor cycling instructor and vice versa. Because the bikes are stationary, heart rate belts and bike-mounted watt displays are the only measures the indoor cyclists can use to monitor their effort level.

The intensity of an indoor cycling class is very dependent on the chosen music, the elements in the particular program planned by the instructor, and instructor's ability to motivate the athletes during the class, which is why no two indoor classes are the same.

2 Related Work

Below we present related research in the area of using technology to improve or enhance enjoyment and social interaction within fitness and exertion games.

The HeartLink project by Curmi et al. is an example of a study investigating the effects of sharing biometric data within the field of sports. Curmi et al. found that sharing real-time biometric data on Facebook strengthened the social tie between athlete and her Facebook friends [3]. Moreover, the study found that athletes were more motivated during the sport event.

Fish'n'Steps is a social computer game, where each participant has a "personal fish" in a virtual aquarium together with other participants' fish [5]. The size of the fish is linked to the amount of steps taken, making it possible for the participants to see how they (their fish) compare to each of the other participants (fish). Being able to see the other participants fish created a stimulating challenge and provided a bench-

marking mechanism, which made the participants aware of their comparative performance [5].

Numerous projects within the field of exertion games use HR as an interaction method for controlling games [8,9]. However, most exertion games focus on creating new fitness activities instead of using technology to augment existing fitness activities. Furthermore, common for many exertion games is that the biometric data is not directly shared between players, but instead used as a mechanism to control or balance the games [6].

In [7], Mueller et al. facilitated that spatially distributed joggers could jog together. The work investigates, among other things, how HR from the participants can be used to facilitate a social experience between joggers. Moreover, Walmink et al. have created a bike helmet with a HR display, which resulted in social interplay and increased engagement in the exertion activity [10].

Compared to the presented related work, our focus is on the motivational effects and challenges of using biometric data for interaction in existing fitness activities.

3 The Race By Hearts Smartphone App

To measure and share the individual HR of each participant in an interactive way, we developed an iPhone application called Race By Hearts (RBH). RBH displays HR, intensity level (based on percentage of MAX HR), and current intensity zone for all users in one list, which is shared between all users as seen on Figure 1. The users' positions in the list are dynamic and based on intensity level, where the user with the highest intensity is positioned on top. This enables the users to control their position within the list by adjusting their effort throughout a session. The use of intensity level, instead of HR, provides a natural balancing of the users' efforts. Each user's HR is captured via a Polar H7 heart rate belt, which is parried to RBH through a Bluetooth 4.0 connection.

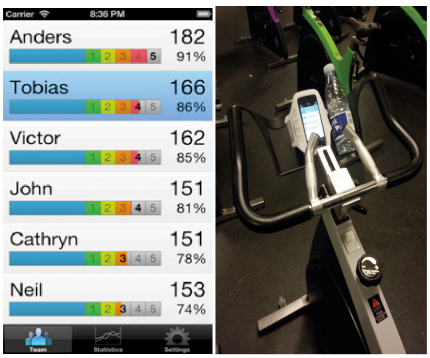

Fig. 1. *Left*, RBH interface. *Right*, test setup where an iPhone 5 running RBH is mounted on an indoor bike.

RBH is strongly inspired by the design requirements for technologies that encourage physical activity presented by Consolvo et al. [1]: 'Give users proper credit for their activities', 'Provide personal awareness of activity level', 'Support social influence' and 'Consider the practical constraints of users' lifestyle'. In RBH, users are given credit according to their HR intensity and are awarded with an earned placement on the participants' list. Hence, the list facilitates social influence between the participants as their placements are determined by their relative performances. As the interactions are based on HR facts, RBH provides personal awareness of the activity level in real-time, and additionally enables users to view a history of past results.

4 User Studies

20 participants (13 female, 7 male) between 20 and 40 years old were recruited to evaluate the experience of sharing biometric data in real-time between indoor cyclists. 17 participants were recruited while they waited for an indoor cycling class to start and the remaining three participants were recruited by word of mouth. A total of seven experiments were conducted over five days, where the number of participants in each experiment varied from two to four athletes. The duration of each indoor cycling class was 55 minutes and five of the 20 participants knew each other on beforehand.

All participants participated once, except three women who insisted to try RBH twice. One participant had never tried indoor cycling before, four had little experience, and 15 were experienced indoor cyclist. The experienced cyclists regularly attended indoor cycling classes between two and six times a week. All participants said they attended indoor cycling classes because they believed it was an effective way to burn calories.

As described in the previous section, RBH uses the percentages of the athletes' MAX HR to calculate and display each athlete's position in the view. If the athletes knew their MAX HR this value was plotted into RBH, otherwise an estimate of the athletes MAX HR was calculated by subtracting their age from 220.

Directly after each of the seven indoor cycling classes ended, we conducted a group interview with the participants about their experience with RBH. The interviews mainly contained open-ended questions about the athletes' experiences with the RBH app. The group interviews were audio recorded and extensive notes were taken during the interviews to allow for further analysis and reflection. We chose a qualitative approach to investigate and understand how sharing real time biometric data between indoor cyclists affected the experience of the indoor cycling class. As we conducted the experiments 'in the wild', it was not possible to quantitatively evaluate and compare the participants' effort to regular indoor cycling classes, as no two classes are the same, as described in Section 1.1.

5 Discussion of User Studies

In this section, we present insights from the user studies and discuss the presence of competition facilitated by technology. We analyzed the data from the conducted interviews, and through extensive brainstorm sessions, using notes and sketching, we derived at two qualities that are enhanced by RBH: Relations and motivation. RBH gives practitioners the opportunity to interact and compete through biometric data in a setting and situation, where direct interaction has not been possible previously, and the two proposed qualities aim to capture the outcome of this new opportunity. However, by introducing competition in a non-competitive physical setting, we also encountered two challenges: Exasperation and Discouragement. These challenges should be addressed in future creations of competitive training systems based on biometric feedback. Lastly, as introducing RBH at indoor cycling classes showed substantial qualities and important challenges, we discuss how technology can be used to facilitate and modify competition and how this affects the exercise.

5.1 Qualities: Relation and Motivation

We discovered that in regular indoor cycling classes the majority of the participants tried to relate to other indoor cyclists, which is difficult to do. They look at facial expression, sweat, and cadence of the other practitioners, as ways to relate. However, the participants also pointed out that this only provided them with vague hints of how the other practitioners where doing, since they had no means to objectively compare their efforts. With the introduction of RBH, the participants were given an instrument for creating a closer relation to each other, which ultimately affected their performance. For instance, one participant said: “It gives an insight on whether you are falling behind, because you can see that others are struggling as well”, and another said: ”If you can see the others relaxing, you can do it yourself as well”, supported by a third participant: “If the others are relaxing, you think ‘I can give it more’, and then you beat them”.

The statements indicate that participants utilize the opportunity, provided by RBH, to relate to each other during indoor cycling sessions. The participants were constantly using the biometric data; as a frame of reference for physiological empathy, an excuse for relaxing, or as a reason to increase the effort. Thus, RBH possibly strengthen social relations between users, which is remarked upon as a strong motivational factor for gym-goers [2].

All participants indicated that they were influenced by the other participants’ biometric data with statements such as: “At some point I was in the bottom of the list and 10% after the nearest [participant], and when I realized it, I instantly pushed myself harder to get to the same intensity level”. The simple dynamical ranking of users in RBH, seemed to work as a game mechanism, where being in the top was the most desirable and being in the bottom was undesirable, exemplified by remarks such as, “He [the instructor] said to ride in single pace, but I could see that you both were going faster, so I refused to be down there [the bottom of the list]”, and, “You give a

little extra to keep it [the position in the list] when you are finally op there [the top of the list]".

The comments indicate that the simple biometric interaction between participants mediated by RBH, introduced an element of competition to the class that is not possible during normal indoor cycling classes. This element of competition motivated the participants to increase their intensity in order to compete with the other participants, resulting in a more efficient workout.

The two qualities, relation and motivation, indicate that sharing biometric data in real-time can help facilitate social relations and enable competition between athletes in a fitness activity, where neither is possible in regular classes. Hence, all participants except one agreed that RBH made the indoor cycling class more enjoyable.

5.2 Challenges: Exasperation and Discouragement

As described in the previous section, RBH motivated participants to increase effort in order to climb the dynamic list of shared biometric data. However, for one participant the pressure from the others became too significant and transformed into a felling of exasperation, which ultimately caused her to cover the iPhone with a towel. This occurred two-thirds into the indoor cycling class and afterwards the participant stated that, "you look at it all the time, and you think, 'well, I can give a little extra', but in the end it was too much, and I thought 'well, I should just ride in my own pace'". This example illustrates how real-time sharing of biometric data can be a powerful motivational tool as it infers competition. Thus, developers and users should be aware that the consequences of the motivational effects of a competition could lead to exasperation.

In another test, one participant had an exhausting workout the day before, making her legs sore on the test day. As a result, she struggled throughout the session trying to match the intensity of the other participants, which she quickly realized was impossible for her, due to the condition of her legs. During the retrospective interview, she revealed that she was discouraged by the fact that she was not able to compete. The chance of experiencing discouragement is mostly likely to happen if the physical fitness level between users is too significant. Thus, users should aspire to compete against other users in similar physical condition. However, future research should also address how to improve fitness-level balancing in biometric-based competitions, beyond the use of intensity.

The two cases presented in this section point to challenges that can be induced by sharing biometric data between athletes in real-time during exercises. Even though remarks from two participants highlighted negative consequences of sharing biometric data, they both stated that they would rather ride with RBH than without in future indoor cycling classes.

5.3 Facilitating competition using biometric data

Since the findings of our user studies exhibit how influential and powerful the competitive element is in terms of motivation, achieved effort and enjoyment, we

wish to discuss the presence of competition, and how competition can be facilitated and modified by technology. In this discussion, we use indoor cycling as our case, however, the argumentation should be valid to other non-competitive sports as well.

Indoor cycling, like many other indoor fitness exercises, does not naturally provide means for practitioners to compare their effort to their peers. Nevertheless, our study revealed that some indoor cyclists use various visual cues to estimate the efforts of others. However, as no concrete data can be inferred about the level of intensity of other indoor cyclists, these sparse visual cues only work as a vague competitive element.

The use of devices such as HR watches and bike-mounted watt displays facilitates an impartial competition, where indoor cyclists can compete with themselves by comparing their performance to previous achievements. However, several participants from our study commented that they had stopped using these devices after a while, as they ended up always competing against their all time best performance, which often caused a demotivating feeling. We argue that this kind of competition can be described as a subsequent competition in the game-mechanics framework presented by Jensen et al. in [4]. A subsequent competition is defined by having a predefined static goal for the competitor to beat, which compares to indoor cyclists trying to beat their MAX HR or maintain the highest average intensity through a class. According to Jensen et al., this form of competition suffers from an inopportune pressure, which tends to make participants give up early if mistakes are made during the performance or the goal seems impossible to beat. This was exemplified in our study by a participant remarking that, "For a period I used the bikes with mounted watt displays, but I went sick of it after a while, because I kept trying to get higher, but I couldn't".

The introduction of sharing biometric data between participants facilitated a platform for competition, which in our study influenced the relation between the indoor cyclists and improved their motivation. We argue that sharing biometric data in an interactive way, as mediated by RBH, facilitates what Jensen et al. frames as a concurrent competition. A concurrent competition is defined by practitioners trying to beat a dynamic goal, which constantly change in relation to the performance of their opponents. In these competitions, the competitors feel a substantially stronger and more constant pressure, due to ongoing indication of their opponents' progress [4]. This observation was exemplified in our study as well, emphasized by the statements on motivation and in the case of exasperation, presented in the section above.

6 Conclusion

In this paper, we have presented a smartphone application, called Race By Hearts, which enables real-time sharing of biometric data between athletes, thereby facilitating a competition in a non-competitive setting. Through an empirical study, we have shown that sharing biometric data in real-time strengthens social relations between participants, increases their motivation, and improves the enjoyment of the fitness activity. However, we also found that introducing competition based on real-time sharing of biometric data can cause exasperation and discouragement for some ath-

letes if not handled carefully. To put our findings in perspective, we discussed the presence of competition within indoor cycling, and how competition can be facilitated and modified by technology. However, in order generalize the presented qualities and challenges, more extensive studies are needed, both within indoor cycling and other non-competitive sport settings.

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