Understanding the Lonesome Tennis Players: Insights for Future Wearables

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CHI'17 Extended Abstracts, May 06-11, 2017, Denver, CO, USA
ACM 978-1-4503-4656-6/17/05.
http://dx.doi.org/10.1145/3027063.3053102

Abstract
Wearable smart devices enhance athletes' physical activities by providing physical data on their performances. However, there is a high abandonment rate regarding these devices. This study aims to understand the habits and the wishes of the tennis players in order to create a more prolonged and frequent wearable usage. As a preliminary work, we conducted an online survey on the Turkish Tennis Federation's website with 1567 participants. Later we conducted in-depth interviews with 20 professional and international tennis players to get a better understanding of their wishes. Our initial results suggest that with the increase of tennis playing frequency the wearable usage frequency increases, which has not been indicated by previous studies. However, the most striking outcome of the study is the tennis players' need for feedback regarding mental states, which should be considered for future wearables.

Author Keywords
Wearable Technology; Sports; Abandonment; Tennis.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

1. How often do you play tennis?
2. Have you ever used a wearable device?
3. Do you still use your wearable devices?
4. How often do you use your wearable devices?

Table 1. Survey questions

Introduction

Freshly in consumer market, wearable technologies such as activity trackers aid athletes to enhance their physical activities and performance. They are designed to provide personal or environmental data to the user, and in many cases assist to improve health, daily life experience and performance with the feedback. Previous studies demonstrate that, in the short term, these technologies are successful in boosting users' physical activity levels [7,17,21]. However, one third of wearable users abandon their devices within the first six-month of use [16]. Among the reasons of high abandonment rates, [15] emphasized that users evaluate the data provided by wearable devices as irrelevant and not actionable. They further evaluate the maintenance of these devices as complex. Nonetheless, majority of the participants who took part in these studies were random users, whose daily physical activity levels range from low to medium. Based on this observation, we speculated that wearable abandonment rate and usage frequency might vary for people who are already committed to regular and frequent training.

Regular training routine is an indicator of interest in enhancing sports performance. Hence, we assumed that physically active users would be more interested in frequent and continuous feedback. We hypothesized that routine training might be one of the major motivators for more frequent use of wearables. When we started to explore the influence of regular training on use of sports wearables, we encountered that previous studies investigated individually performed sports such as running and cycling [9,14]. However, there are also opponent based individual sports such as tennis, where players' performance is highly dependent on the style of the opponent [22]. Since current wearable devices mostly focus on the enhancement of individual sports performance, they might not be sufficient to address the needs in opponent based sports like tennis. Therefore, we strived to investigate how tennis players currently benefit from wearable technology where the utilization remains unexplored.

Our research contributes to HCI community in exploring initial clues to design more useful sports wearable devices for opponent based individual sports like tennis. We started with an examination of non-professional Turkish tennis players' training and wearable usage habits. Our initial findings of high abandonment rates correlate with the global data [16]. However, we found that wearable usage increases as training frequency increases, which no previous study has suggested. Thus, we decided to hold in-depth interviews with professional tennis players, elite athletes, to gain a more robust understanding of their wearable usage habits since they are frequent trainers. Our findings may inform future wearable designers in ways to encourage more frequent and lasting wearable usage.

Preliminary Work

Participants and Procedure

We conducted an online survey with 1567 members (1152 males) of the Turkish Tennis Federation, on their website regarding players' training and wearable usage habits (Table 1). The age of the participants ranged from 18 to 73 (M=42.35, SD=12.14). All of the participants were registered as former tennis players and some continue to play tennis on a regular basis.

Analysis

We found that abandonment rate was 28.40%, similar to previous studies [16]. 250 participants (16%) stated that they have previously used a wearable device

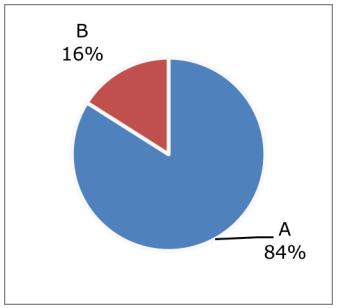

Figure 1. Wearable usage percentages
(A) People who have never used a wearable device
(B) People who have used a wearable device

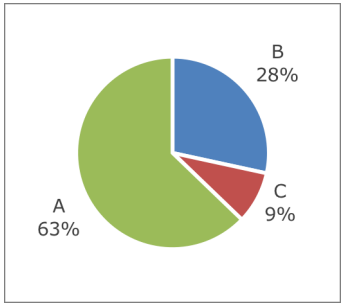

Figure 2. Wearable abandonment percentages
(A) People who still use all of their wearable devices
(B) People who abandoned all of their wearable devices
(C) People who abandoned some of their wearable devices

(Figure 1). Among them, %31 train on a daily basis, 40% train 3 – 4 times per week, 25% train tennis 1-2 times per week and 3% train 1-2 times per month.

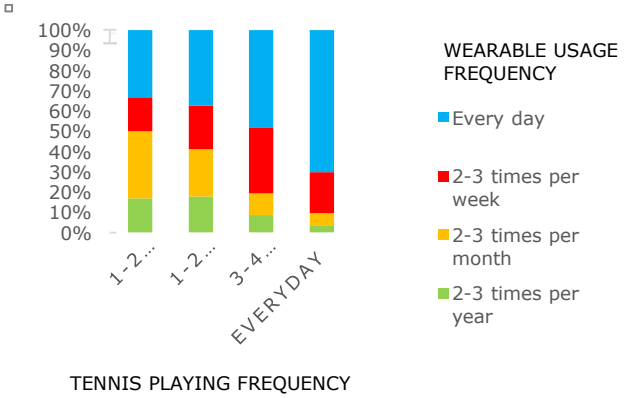

Figure 3. Wearable Usage Frequency * Tennis Playing Frequency Cross Tabulation

Of the tennis players who train every day and own a wearable device, 71% use wearable devices on a daily basis, 20% use 2-3 times per week, 6% use 2-3 times per month and 3% use 2-3 times per year (Figure 3). As we see, wearable usage frequency decreases as the tennis playing frequency decreases. Thus, we can infer that there is a positive correlation between wearable usage frequency and tennis training frequency.

20 In-Depth Semi Structured Interviews

We decided to hold in-depth semi structured interviews with professional tennis players who train almost everyday to obtain detailed insights about elite athletes' wearable usage habits and expectations from technology.

Participants

We conducted the interviews with 20 international professional tennis players (13 males). They were from 14 different countries to prevent cultural bias since the preliminary work was done only with Turkish players. The participants' age ranged from 18 to 27 (M=20.6, SD=2.84). All were active in tournaments, except one who was coaching in that period due to injuries.

Procedure

We conducted the interviews at Tennis Organisation Cup organized by ITF. We asked participants to describe their general tennis training experience, use of wearables and expectations from a 'magical' future device that could do anything they wanted. We had various open-ended questions to encourage them to share any other information about the topic. Each participant signed an informed consent form in advance and each interview lasted around 20 minutes. Except two participants who did not want to be recorded, all of the interviews were recorded via a video camera.

Outcomes and Analysis

Tennis Training Experience

Players' daily and weekly training routines were very similar. They train six days a week, a total of 5-6 hours a day with 3-4 hours of tennis training and 1-2 hours of cardio and fitness.

Use of Wearable Devices

The most commonly used wearables among 20 participants are heart rate bands, branded as either Polar or Garmin. 15 participants mentioned using them before. Nonetheless, the use of these devices is required by their coaches and can be stated as mandatory and infrequent.

Figure 4. Interview session with p11

Looking into voluntary use, 9 out of 20 participants used wearable devices before and 5 of them abandoned their devices. Before we started our interviews, we thought that the abandonment rate would be low for these elite athletes, however we found that it is still high. Additionally, their abandonment duration mean is 6 months, which matches with previous data [16]. The brands and models of these devices are Nike Fuel Band, Fitbit, Garmin and Adidas MiCoach. None of these are specified for tennis playing experience, although p19 stated that he bought MiCoach because it was marketed through tennis: *"It shows how much I run, the speed and the sprints; but the info is too general, not specific. It is not helping other than entertainment and definitely has no help for tennis."* –p19. Similar to p19, general concerns were that the information provided by these devices is too general and irrelevant for professional tennis players as they only measure steps, distance, speed, calories etc. Also, the information is not considered reliable or precise enough for the individual. Some did not even use these devices for their true purposes such as p4 using the Nike Fuel Band only as a regular watch. The other reasons were maintenance issues like mandatory purchase of further accessories or interruption of use due to lack of water resistance. These findings further endorse the claims of the literature [15].

Out of 9 participants who used wearable devices before, 4 were still using their wearables with the duration mean of 9 months, which is a little above the threshold [16]. The brands and models of these devices are Sony SmartBand, Nike GPS Watch, Apple Watch and Tennisensor. Among these devices, Tennisensor intrigued us because it is a complementary device attached to the bottom of the racket and measures tennis related information. However, its user stated: *"It gives me information about the speed and where I touch the ball on the racket…I use it once a week because the racket is heavier and the balance is not the same…It helped my tennis playing experience little bit, but not revolutionary."*-p20. His information implies that giving even a little tennis related information makes him use the device even though it is inconvenient due to the balance difference. This supports the claim that wearable usage frequency can increase with more related information given [4]. When we asked whether he would use it more frequently if the balance was the same; he answered: *"I would use it every day."-p20*. Thus, comfort and convenience are other crucial issues considering wearable devices as previous studies suggest [8].

As we move on to the 11 participants who have never used a wearable device before, we observed that 4 of them use another modality, activity-tracking apps. They stated that they use these apps to measure speed, distance, steps, calories and heart rate and they don't feel the need to use any wearable device. The data provided by the current wearable devices do not differ from data provided by these apps. Therefore, it supports our previous claim that wearable devices do not provide adequate specific data for elite players.

When we asked *'Why did not you use?'* to these 11 participants, the majority answered with two aspects: *"There is no need to buy. We don't really care about the calories or other information. In my case, I burn so many. I don't have problems with my weight."*-p1, *"No one [coach] told me to use one."*-p3. The answer of p1 suggests that they already know their physical data from their training and do not need an external device to further support it. They can understand from their

physical condition. Their coaches already provide the related data and make necessary suggestions. On the other hand, the answer of p3 shows that they are highly dependent on their coaches' suggestions; so if the coaches do not require them to use a device such as a heart rate band, they don't use it. Thus, we speculate that, the coach is another stakeholder that affects the use of wearable devices by tennis players.

Expectations from a Future Device

Since our data demonstrates that wearable devices are inadequate for elite tennis players, we strived to understand what kind of information tennis players expect. In this section we present initial recommendations regarding aspects of expected information, according to their order of importance.

Mental support is crucial. The most interesting material when we asked them '*What do you want this device to measure?*' was: *"If it could measure anything or do anything, probably I want it to tell me what is going on in my brain."*-p7. 5 of the participants explicitly reported their wishes for mental data as well as physical. Another 2 participants implied similar wishes, although they did not state specifically. These participants mentioned that they are already confident in their bodies and physical conditions, and there are coaches to help them train their bodies. However, they reported that they feel anxious and stressed during some specific situations in which they find it hard to relax. They wish to see the reasons for their stress and how their mind works, what and why they think about: *"I think mental data gives the cause, which will lead to easier physical performance."*-p7. Additionally, 1 participant stated she would like a device to motivate her during her downs. Another participant wants to know how he behaves on the court, because when he is playing he does not have any idea of what he does. All of this information shows us tennis players feel alone in terms of mental support and try to find a way to overcome this loneliness.

The presented information should contain tennis specific data, recovery rate and nutrition. 7 of the participants reported they would like specific and precise technical data regarding their tennis performance such as where the ball hits the racket, the speed of the stroke, how much the ball bounces off the floor, general mobility on the court and weak points and errors regarding their own game. Other 7 stated that they would like to know about their recovery rates. They want to know how far they can push their bodies, when to rest and when to train again. 4 participants reported they would like to see information on nutrition. They want their own, precise, perfect diets personalized for themselves. This doesn't just apply to calorie counts but also to the type of food regulated according to their recovery rates.

The data should be interpreted and also be shareable. 13 of the participants specified they would share their data with their coaches: *"I think the coach would be very important because he would interpret the data better and give you more feedback. He would tell you things maybe you didn't think it's there."*-p18. This comment reveals that only the raw data is not enough but a thorough interpretation is also needed. This outcome further supports our claim that the coaches' opinions are highly valuable. Therefore, a potential device should satisfy coaches' opinions.

The type of feedback should be customizable. 9 participants specified they would like to see statistics and numerical values as feedback. Another 3 stated

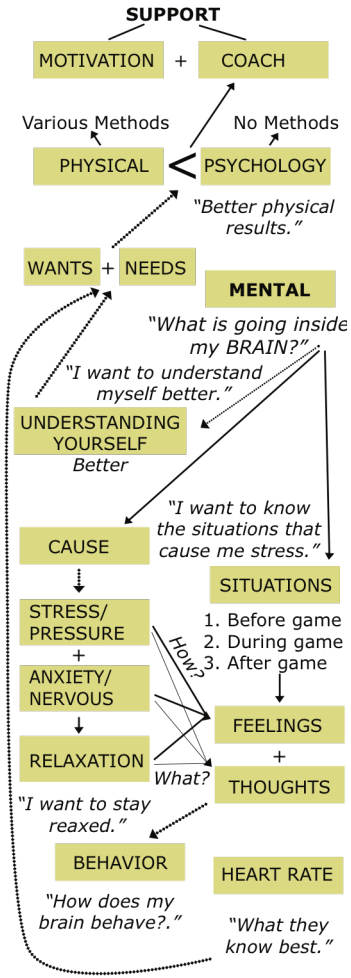

Figure 5. Mind-map of Mental Data

they would prefer graphs and diagrams. They believed quantitative information is free from distractions: *"I think numbers would be one of the best ways because you will know exactly, precisely. Numbers don't lie."*-p18. 5 participants preferred to see qualitative feedback as direct sentences and clear instructions regarding what they should do: *"I would prefer a device which comments on the statistical data as a writing feedback."*-p14. As we understand, there are different desires for the type of feedback. Thus, a future device should be designed to be capable of providing several types of feedback and should be customizable according to individual desires.

Comfort and convenience should be the top priority. Participants expressed a possible device should not obstruct or distract tennis playing experience.

Conclusion & Future Work

The data from our preliminary work indicated that wearable usage frequency increases when tennis-training frequency increases. However, the abandonment rate is still high among frequent trainers, which resonates with the literature regarding random users. We discovered that abandonment is due to the type of information given to the players. They prefer specialized devices that give tennis related information rather than multi-purpose activity trackers. Further, they want qualitative interpretation of this quantitative information like their coaches do. It gives an insight of a possible future wearable device that learns and comments on the behavior of tennis players through machine learning and artificial intelligence. Also, there is a potential to better integrate coaches to this system, where they can be more involved in the data screening and interpretation of their trainees' information. Our findings provide a valuable guideline for further studies on designing sports wearable devices as it refers to the importance of considering contextual differences for wearable design, development and research communities together with sports communities.

Additionally, our most interesting finding is the need for mental support. Most of the players think they are already physically fit. Even if they want to improve their physiology, they can get physical information either from their coaches or other modalities. On the other hand, they stated that tennis is a mentally tough sport because it is an opponent based individual sport, which burdens the self with extreme stress. Thus, most of the tennis players would like a "magical" device that helps them to understand intangible and psychological aspects of their life. We think that this finding could open up new research venues for designing wearables.

As a first step, we prepared a mind-map that summarizes players' expectations (Figure 5). We plan to conduct more in-depth qualitative interviews on mental data using this mind-map as a guideline. The mind-map inspired us to investigate mental needs further since this is clearly one of the most important needs of tennis players who often travel alone and need to deal with the stress that comes with such a competitive sport. Once we understand their mental flow and what we lack to identify it, we can suggest improved design recommendations on wearable technology specifically for supporting mental aspects of tennis players.

Acknowledgements

We thank the Turkish Tennis Federation and GD Tennis Academy CEO, Gökhan Dönmez for their generous help on providing eligible users for this study, and Gülben Şanlı for her initial analysis of the online survey.

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