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EXPECTED MOTIVATIONAL AND TRAINING EFFECT AND OPENNESS TO TECHNICAL CYCLING EQUIPMENT

ABSTRACT

Although technical equipment used in cycling is an expanding sector, studies on the actual use and the openness towards technical cycling equipment are rare. This study tries to fill this gap and investigates devices used while cycling like stopwatches, pulsewatches, mobile phones, cyclometers, navigation systems and music devices. The study showed that these devices are often used and that they can be found on all levels of drivers. The frequency of use of pulsewatches, cyclometers and mobile phones during cycling is higher for professional cyclists than for hobby cyclist and amateur cyclists. The use of navigation devices was seldom; probably those could not yet establish themselves in the cycling sector. Music devices were judged highest in their motivational effect, followed by cyclometers and pulsewatches. Users especially appreciate technical devices in cycling for training functionalities (like measuring distance, duration, speed, pulse and storing training data), listening to music (for distraction, motivation and relaxation) and phoning in the case of emergencies.

KEY WORDS

HCI in Mobile, Ubiquitous, and Pervasive Computing Contexts, Psychological Aspects of HCI, Cycling, Cyclometer

1. INTRODUCTION

Because the development of the computer has changed during the years, also the devices for the cyclists have developed rapidly. Computer science in sports in general is an upcoming research topic (Perl, 2005; Reilley, 2005), especially in ubiquitous, and pervasive computing contexts (Chi, Borriello, Hunt, & Davies, 2005), Nevertheless studies in the cycling sector are rare up to now.

The increase of functions for bike computers and the big variety of bike computers are a meaningful indicator of the risen advantages and the consequent demand for computer aid in this section. Technical developments do have an influence in the cycling sector, no matter this sport is performed frequently or seldom.

The fact that sales figures for bikes increased during the last 20 years also shows the important role of bicycles in the world and in Austria.

Although technical equipment used in cycling is an expanding sector, studies on the use and the openness to its use are rare. This study tries to fill this gap.

In this study we focused on the overall use of a bicycle itself, on the use of home trainers and ergo meters and which electronically devices are used during the use of one of the indicated training facilities. Our study focused on the devices in cycling and the overall technical equipment used by cyclists. Moreover we have also included music devices and mobile phones in this study, as they also have improved their functionalities and provide a full variety of functions to the customer.

2. THEORY

During the last 20 years the utilization of devices in cycling has changed dramatically. The computing devices now have capabilities to be used with an affordable price also for the average consumer.

The devices used in the beginning had only some functions like current speed, day trip measurement and total trip measurement. The devices were connected via cable and did not show any flexibility for the user to have other additional information.

Regarding computer devices for cyclists, tachos years ago only had a maximum of 3 functions (speed, total distance, daytrip distance). For a cyclist a portable radio was pure luxury to have it on the cycle bar, a mobile phone was too heavy and its batteries not working for long time neither was the infrastructure suitable to fulfill the needs.
Today a computer has a minimum set of functions like automatic start / stop, speed, average speed, day distance, total distance, time, light and much more (Jekel, 2006). The developments on the computer sector have increased the functionality for these items. The customer behavior has also changed; today more than 60% have a cycle computer on their bike to at least see the speed and the trip distance.
More experienced drivers or drivers with a higher usage of a bike also use computer aided devices with even more functions, especially heart rate functionality. Modern cycle computers come more frequent also with capabilities like weather forecast, barometer function, altitude display (Borchers, 2005) and with a spare module for heart rate measuring. For heart rate measuring the device is delivered with a belt which is worn around the chest to deliver the heart beat rhythm being displayed in the cycle device on the handlebar. These devices deliver even more functionalities like, average heart beat during the training session, heart beat zones the cyclist wants to train (with an alarm getting over or under with his heart rate) kcal used during the training session calculated with his age, height and weight. Pulse driven computer aided devices have given much more possibilities also to the not so experienced driver to also improve their training sessions.
Using cyclometers in combination with computer aided simulative models to analyze training processes in cycling is an upcoming research field (Ganter, Witte, & Edelmann-Nusser, 2006). There are also efforts to develop mobile fitness guides, giving feedback navigational and training support (Baca & Kornfeind, 2006; Buttussi, Chittaro, & Nadalutti, 2006)
Navigation systems with GPS functionality are rather new advancements in the cycling sector, although a variety of products is already available (Felchner, 2004).
Other equipment used by cyclists are for example a mobile phone and music devices. Mobile phones are now modern to be taken with in almost every situation. They are also used in almost every situation. Personally they had been very useful when you undertake a bike tour, get in trouble and be able to call for help. Nowadays there are invented laws to write penalties for bike drivers speaking on their mobile during cycling.
Music devices are very common used by especially young people. IPODs or MP3 players, stored with your favorite music are used very frequent. The positive effects of listening to music during training especially include enhancement of motivation and enjoyment (Wijnalda, Pauws, Vignoli, & Stuckenschmidt, 2005).

3. EMPIRICAL STUDY

3.1 Research Questions

The main research question of the study was, how open cyclists are to the use of cycling computing as well as to other technical equipment. We tried to cover all possibly used devices during cycling and therefore selected the following devices for our study:

- stopwatch
- pulsewatch
- mobile phone
- cyclometer
- navigation system
- music device

We tried to get an overview of the usage of these devices by cyclists. The following detailed research questions were:

- Are there differences between hobby-, amateur and professional cyclists concerning their use of technical equipment in cycling?
- Is there a correlation between the number of kilometres per year and the use of cycling computing?

Furthermore we tried to investigate benefits users expect from technical equipment:

- Which devices do support training and which do increase motivation?
- Which benefits do users expect from technical equipment?

3.2 Questionnaire

In the study an online questionnaire created by the online tool oFB (Leiner, 2007) was used.
In the set of questions we had several focuses:

First we wanted to find out how the bicycle was used by the participants. We placed questions like how many kilometers participants drive, types of bike they use and how often they do use their bike.

Secondly we focused on technical equipment used: We placed questions with the scope for pulse watches, mobile phones, music devices or tachometers with extended functions. Questions were asked like: "Do you use a pulse watch during cycling?", "Do you hear music during cycling?"
The third focus was the purpose for devices used: here we tried to find out why persons use these devices. We asked questions like: "Why do you take a handy along on a tour?", "Do you compare your information stored on a pulse watch?", "How does music support you during training?"
The questionnaire was online for 12 days after recruiting participants and data was imported and analyzed with the statistical software SPSS.

3.3 Sample

Altogether 68 questionnaires could be collected. In the context of an university course on Human Factors, participants searched for subjects who would fit in the study meaning that they would go cycling regularly as a hobby or professionally. An invitation to take part in the study was sent per e-mail to acquaintances who were known to go cycling and to costumers of a cycling shop. Furthermore the invitation and the link to the questionnaire were posted in relevant cycling forums.
From the 68 study participants 28 were women (42%), 39 were men (58%). The age of the participants ranged from 18 to 40 (Mean=24.91, SD=4.20). Concerning formal education, 64.18% of had at least a highschool degree, 16.42% an university degree.

3.4 Results

3.4.1 Cycling frequency and use of technical equipment

Concerning the cycling frequency, 32.84% of the participants ride the bike daily, another 32.84% 1-2 times a week and the rest ride less frequently.
Most participants (31, 46.27%) judged themselves to be amateur cyclists, 26 participants (38.81%) as hobby cyclist, and 7 as professional cyclists.
19% of those participants using a cyclometer or a navigation system do also transfer trainings data on their home PC for further analysis and storage.
Figure 1 shows the overall frequency of use of all devices. Mobile phones are used most often (41 of 60, 68%), probably because most cyclists owe a mobile phone and probably take it with them also when cycling. Music devices are used by 36 out of 64 study participants (56%), pulse watches by 54%. Cyclometers are used by 53% of the cyclists, whereby 27% use them always when cycling. Stop watches are used by 13% study participants and only two study participants (3%) use navigational support (infrequently) during cycling.

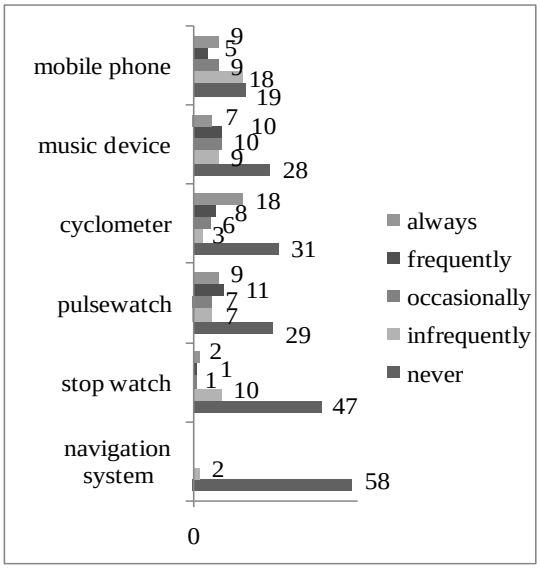

Figure 1: Frequency of use

3.4.2 Cycling user types

Study participants were asked to judge themselves which group of cycling user types they belong. The following user types were distinguished:

- **hobby cyclist**: rides the bike between several times a month and a week and uses it e.g. for distances in the city
- **amateur cyclist**: rides the bike at least once a week is interested in training advancements
- **professional cyclist**: takes part in cycling contests, rides the bike almost daily and rides most kilometres per year

Since frequency of use data was rank scale data, a non-parametric Kruskal-Wallis test was calculated to find out whether the frequency of use of technical equipment differed between different cycling user types.
Pulsewatches, cyclometers and mobile phones are use most often by professional cyclists during cycling, less often by hobby cyclist and least often by amateur cyclists. For stopwatches and music devices there are no difference between cycling user types. There are also no differences concerning the use of navigation systems, this is probably due to the fact that only two study participants used navigational support during cycling. Detailed results can be found in Table 1.

Table 1: Cycling user type and frequency of use of technical equipment, df=2

	User type	**n**	**Mean Rank**	**Chi-Square**	**p**
stopwatch	hobby cyclist	26	32,23	1,44	0,486
	amateur cyclist	27	28,39		
	professional cyclist	6	27,58		
pulsewatch	hobby cyclist	26	27,21	6,92	**0,031***
	amateur cyclist	29	31,07		
	professional cyclist	6	47,08		
Mobile phone	hobby cyclist	25	24,42	6,71	**0,035***
	amateur cyclist	28	32,34		
	professional cyclist	6	42,33		
cyclometer	hobby cyclists	26	28,94	8,62	**0,013***
	amateur cyclists	31	31,45		
	professional cyclist	7	50,36		
navigation system	hobby cyclist	26	29,00	1,15	0,563

	amateur cyclist	27	30,07		
	professional cyclist	5	29,00		
music device	hobby cyclist	26	28,10	1,91	0,385
	amateur cyclist	28	32,11		
	professional cyclist	7	37,36		

Similar results could be found, when correlating the estimation of riding kilometres per year and the frequency of use of technical equipment. There are medium correlations between riding kilometres and pulsewatch (r=0.43, p=0.000), mobile phone (r=0.41, p=0.001) and cyclometer (r=0.38, p=0.002) and no correlations with stopwatch, navigation system and music device.

3.4.3 Overall Judgment of technical devices

Most participants of the study think that technical devices used in cycling are useful, support training and motivation and have a high usability. As can be seen in Figure 2 in detail only a few participants say that technical devices in cycling are useless (8; 88%) and have no added value (6; 61%). The usability of those devices is judged high. Only 1% of participants think that they would need intensive training to be used, nobody judged them as hard to handle. Most negate that they are complicated (1; 99%) and have low usability (8; 88%).
Although 91% of participants (61 of 67) think that using technical devices does not disturb the cycling, 44% (35 of 62) are aware that technical devices can also be a security risk.
69% of study participants judge technical devices to facilitate training, 84% wrote that they are motivating and 88% that they support training.

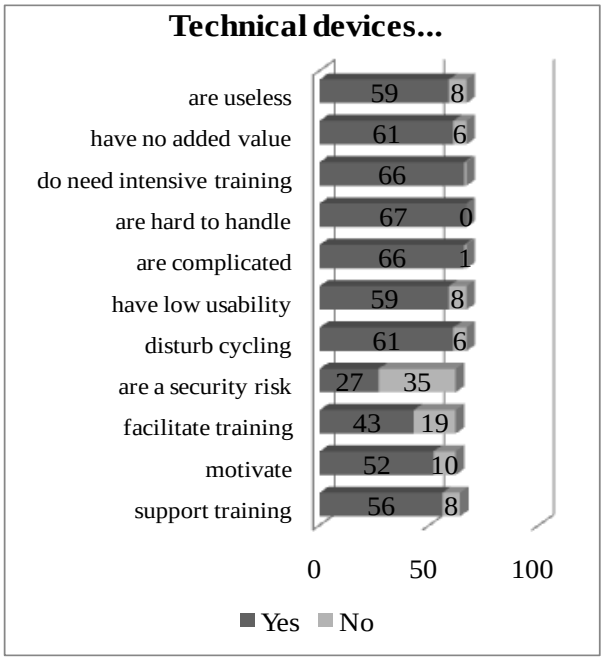

Figure 2: Judgment of technical devices

3.4.4 Training Support vs. Motivation by technical equipment

In the study participants were asked to indicate which devices do support training and which do increase motivation. Music devices, pulsewatches and cyclometer were nominated most often. Music devices were judged 34 times to be motivating and 19 times to give training support (presumably also because of motivational support). The training support of pulsewatches was judged higher than its motivational support (20 vs. 8 nominations). For cyclometers training support and motivational increase were judged equally (14 nominations each). Mobile phones, navigation systems and top watches do not play a major role in training and motivational support. Figure 3 depicts all nominations for training and motivational support of devices.

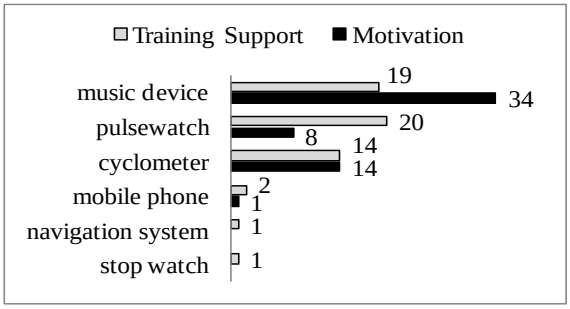

Figure 3: Training Support vs. Motivation

3.4.5 Expected Benefit from technical equipment

Altogether there were 67 statements on which benefits users expected from technical equipment in cycling. A content analysis was carried out to quantify main aspects mentioned by participants.

3.4.6 Training functionalities

Many participants wrote that they would want a display of the driven distance (15, e.g. “driven distance”, “kilometers”, “daytrip distance”) and the total distance (2). The display of the actual speed was mentioned 10 times (e.g. “tacho”, “speed calculation”, “pedaling frequency”) and also the average speed was noted 3 times (“have calculated the actual average speed during the training session”).
A further aspect mentioned was measuring pulse (9 nominations, e.g. “region of the pulse”, “measure the heart rate for having the right training parameters”), especially for cardio controlled training sessions (4 nominations (“pulse for persistency training sessions”, “pulse watch: for controlling the training sessions and the pulse regions during the training – also to have an exact control and the difference between your personal feeling and the real value of the heart rate”, “to make sure to train with the right pulse frequency and to be informed about the exact rates and conditions”).
Controlling training enhancements was also a topic mentioned by 5 study participants (e.g. “to steer the training sessions and to control the developments made, “better control of the data achieved during training sessions”, “to have diagrams to compare the performances - training sessions, same driven distances in other circumstances, etc.”).
Four mentioned the benefit of storing training data on the PC (e.g. “recording training data on the PC and compare the stored information delivered by the pulse watch”, “to compare the different sessions of training in one chart provided by the pulse watch software”, “data collection and forwarding of data”.)
Altitude measuring was also mentioned twice (e.g. “partly you can use the altitude to orientate on a paper card where you are”).
Further single nominations were “burned calories”, “metabolic data”, “to get the spectrum of trainings and “persistency training”.

3.4.7 Timing functionalities

Concerning timing functionalities 9 study participants noted the benefit of knowing the duration of the workout (e.g. “time of the session”, “duration of the workout”, “driving time”, “to know about the duration”, “compare the collected times for same routes used several times to compare parts of the track or uphill sections”). Further three mentioned using a stopwatch e.g. “elapse the time”).

3.4.8 Music devices

Five persons wrote that they simply want to listen to music during training (e.g. “to listen to music or radio”, “to listen to music during the trainings session”, “during practice I want to hear music”).
Further five wrote that music helps with distraction (“to have distraction with the music”, “to listen to the music to support distraction”, “to get positive energy out of the distraction through music”, “use a mp3 player to get distraction”)

Music devices were also used for motivation (e.g. “having a diversity of motivation aspects which arise hearing music”, “to steer the training session in a way”), relaxation and simply amusement.

3.4.9 Mobile phones

Mostly mobile phones were mentioned in combination with emergencies (5 nominations, e.g. “on tours while not having company”, “in case of emergency”, “to call for help”, “In the Vienna forest for example you have a good signal and it makes sense to take along a mobile phone”, “in problem case - in case of a defect”). 4 participants wrote that they take mobiles with them for urgent calls (“to make a phone call if something urgent comes up”) and further two just want to be available (“to be available”, “to be available - partly in case of a problem”). Further benefits of mobile phones while cycling were to have the time and simply to communicate.
Table 2 summarizes all benefits of technical equipment used while cycling study participants had mentioned.

Table 2: Content analysis of expected benefits

Devices/Functionalities	**nominations**
Training functionalities	
Driven distance	15
Total distance	*2*
Speed	10
Average training speed	*3*
Pulse	9
Cardio controlled training	*4*
Controlling training enhancements	5
Storing training data on the PC	4
Altitude measuring	2
Timing functionalities	
Duration of the workout	9
Stopwatch	3
Music devices	
Distraction	5
Listening to music	5
Motivation	3
Relaxation	3
Amusement	2
Mobile phone	
Emergency	5
Urgent phone calls	4
Availability for others	2

4. CONCLUSION

Due to technical innovation in computer science in general and in the field of sport science, technical devices in the cycling sector have developed rapidly. Possible functionalities have increased throughout the years. Nevertheless studies in the cycling sector are rare up to now. This study tried to fill this gap and examines benefits users expect from technical devices, their judgment of training support and motivation effects and their overall openness to technical cycling equipment.
The study showed that due to developments in the computer science electronic devices are used more frequent than ever. Users show interest in using information given by technical devices in cycling for training functionalities like measuring distance, duration, speed, pulse and storing training data. Music devices were judged highest in their motivational effect, followed by cyclometers and pulsewatches. Listening to music helped in distraction, motivation and relaxation.
Most cyclists carry their mobile phone while cycling and they appreciate being available and having the possibility to call for help in emergencies.

The use of navigation devices by the participants of the study was seldom; probably those devices could not yet establish themselves in the cycling sector. It can be assumed that as those electronically devices are improving in the future regarding size and functions they will be used more frequently.
With the results of our study we hope to provide new insight into the user's perception on technical equipment in cycling.

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