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Technology Use with Winter Cycling

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In this paper, we present our online survey (n=81) results related to technology usage in winter cycling. Snowy, cold, and dark winter conditions set special challenges for cyclists. The findings highlight that the most commonly reported challenges relate to fast battery drainage in the cold, and the use of gloves which hinder the use of touch screens and general dexterity with equipment.

CCS Concepts: • **Human-centered computing → Human computer interaction (HCI)**.

Additional Key Words and Phrases: Winter, cycling, outdoors, sports, HCI

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1 INTRODUCTION

Outdoor recreation has been proven to be good for both physical and mental wellbeing [10]. Biking is an activity which combines many beneficial factors, as it can be conducted e.g. for commuting, recreation, sports, and health and wellbeing in general. The Covid-19 pandemic rapidly affected society, creating challenges in many sectors of everyday life, ranging from direct health concerns to practicalities caused by social distancing requirements [5, 11]. A large scale survey conducted in nine European countries revealed that during the pandemic lock-down period, physical inactivity time increased by 50% on average [11]. On the other hand, it has been reported that the pandemic caused a drastic increase in bicycle sales [1], to the point that manufacturers could not keep up with the demand [15]. Biking offers a way for physical activity and recreation within the requirements of social distancing. Thus, examining practical issues affecting biking is more timely than ever.

In this paper, we focus on technology usage while cycling. Biking necessarily requires some technology use, e.g. lights, as a legal requirement, but in the era of wellness tracking and smart phone apps, the technology use expands beyond the basic bicycle equipment. There is also a trend to invest money into the hobby equipment, and opportunities for specific tools and applications are expanding. In the following, we address the special context of winter cycling, which sets special requirements for biking and the usage of technology. In the scope of this paper, with winter, we mean conditions with snow, ice, and temperatures below zero Celsius. Figure 1 illustrates the context of our study, biking in winter.

2 RELATED WORK

Interacting with technology in the outdoors and nature context has lately gained increased attention among human-computer interaction researchers [3, 9]. Bicycles are an popular mode for exercising outdoors. It is also globally a

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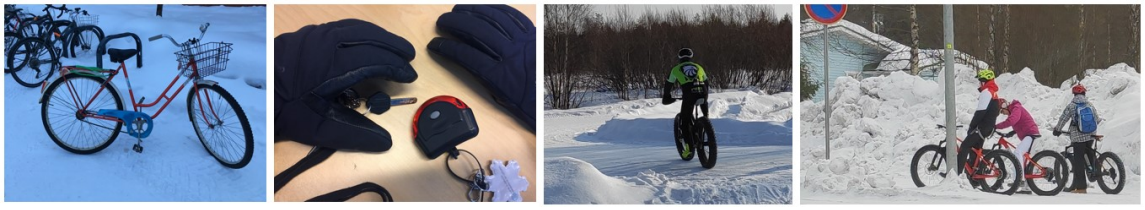

Fig. 1. Winter cycling requires handling cold, snowy and dark biking conditions, and takes place both in the urban environment and outback tracks.

practical means for commuting, promoting at the same time sustainability and a healthy lifestyle. Generally, many of the concepts and prototypes related to HCI while biking are related to safety. For instance, Dancu et al. have explored projection to improve the visibility of turning signals [2], and Matviienko et al. audio, haptic, and visual warning signals for child cyclists [8]. Today, mobile phone usage is truly omnipresent, and they are used also during sports and commuting activities, including cycling [7]. This has led to attempts to improve the safety of bikers (and the people surrounding them) while using a mobile phone, so that the visual attention of the biker would not leave the road and hands could be kept in the handlebars. For instance, concepts and prototypes suggesting smart phone controls attached to the bike [16], or providing navigation information projected on a heads-up display or on the road [2], or with a vibrating tactile belt [13], have been suggested. These examples illustrate that the topic of technology use while biking inspires HCI researchers, who are seeking solutions that could be used by large masses of users in the future.

In our research, we wish to focus on a specific context of winter use. Winter is an interesting design context, as with snow, ice, and frosty temperatures, it creates additional challenges for the use of outdoors technology. HCI research has reported how winter sets challenges for urban computing, where snow can e.g. hide public displays [17]. Cold also affects negatively on the fine-motor skill performance, hindering e.g. the use of a mobile phone [12]. Sports tracking technology and user interfaces with them, e.g. sports watches, must endure the challenging sports conditions [14]. Possibilities of technology and new concepts in winter outdoors sports have been explored e.g. in the context of skating, snowboarding, down-hill skiing, and cross-country skiing [4]. Our current research reported in this paper aims to add on understanding into the area of technology use in winter sports by studying another sport activity, winter biking.

3 SURVEY ON WINTER BIKING

3.1 Survey Design and Participants

To chart the practices and preferences in winter cycling, we organised an online survey. This survey was constructed of three sections, where the first inquired background information, such as the age, gender, and how frequently the person rode a bicycle. The second part focused on understanding the use of technologies in biking, i.e. what kind of technology the participants used in winter and summer biking, and how they attached or carried. The third section aimed to chart the challenges and ideas related to the technology use in winter. Participants could also share images to illustrate these situations.

In total, there were 101 responses to the survey. Filtering out the participants not cycling in the winter, left a dataset of 81 responses. The responses were from 64% women and 33% from men, and 3% identified as other or did not wish to respond. The largest age group was 18-15 years (48%), the second biggest was 26-35 (28%), and third largest 36-45 (12%). A vast majority (98%) lived in Finland. Almost half (45%) of the participants used their bicycle on daily basis, and

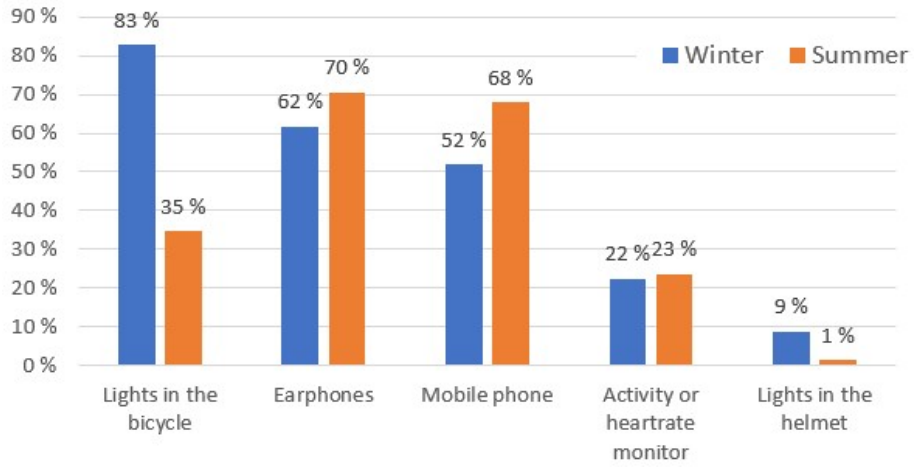

Fig. 2. Reported technology use in winter and summer biking (total n=81).

21% weekly during the winter season. A quarter (25%) reported to cycle on monthly basis, and 18% a couple times in a winter.

3.2 Results

The most of the participants (85%), used the same bike in winter and summer. Only 9% used a different bike for winter and summer, and 6% reported using a different bike sometimes. Winter studded tires were used by 28% of the participants.

Participants' technology use during winter and summer biking is summarized in figure 2. The most common technologies used in winter were lights, earphones, mobile phones, and activity monitors. In total 83%, used lights attached to the bike itself, and 9% on the helmet. Other technologies identified by the respondents were reflectors hung on a bag (participant #2), spoke reflectors (#4), bell (#4), GPS (#7), and an electric bike (#49). Also, there were two respondents who claimed not to be using any technology. Places where the respondents attached the technology were the handlebars (73%), ears (51%), pocket (47%), helmet (14%), rear basket (10%), wheels (5%) and front basket (4%). Other places mentioned were bike fork (#20, #47) and saddle (#20, #19, #50), or a light attached to a backpack (#1, #38), rack (#30, #47), or wrist (#50).

The technology use between summer and winter biking differed somewhat. Not surprisingly, the lights were used more extensively in winter. Interestingly, other common technologies, i.e. mobile phones, earphones, and activity monitors, were used almost as much in winter as in summer, figure 2. When explicitly asked, approximately half (56%) of the participants thought that their technology use was different in winter than in summer biking. Most commonly, the use of lights was commented to be different. For instance, participant #11 commented, *"In winter cycling, I use lights that blink. They are not needed in summer cycling."* Also the influence of the cold context was highlighted, e.g. that one should take care how to keep the mobile phone warm while using a hands-free (#20), and to use bigger earphones to keep the ears warm (#6), e.g., *"In summer, I can use my phone while riding, but in winter not so much because of the cold. In winter, when I go, I can for instance put a podcast on already when still indoors"* (#33).

The challenges with batteries were commented both as a contrast between winter and summer, as well as when the specific challenges of winter biking were requested. The cold weather was commented to shorten the battery life (#6,

#7, #11, #13, #15, #20, #57, #60, #63), and the condition was commented e.g. as follows: *"...some lights typically turn off during the winter due to the cold (you need to test and find the ones that still work in the very cold weather). Same goes for the phone, I use it the same as in the summer, but cannot keep it outside too long or the battery might die (I keep it in my coat). My hands also get cold as smart phones are not easy to use with gloves!"* (#11). In addition to the battery drainage, another common difficulty related to the use of gloves, which was mandatory in minus degrees. This was illustrated also in a photo, see figure 1. It was hard to use a touch screens with gloves on (#20, #4, #11, #63, #69), and one needed to take them off in order to operate the lights or the bike lock (#1, #2). These issues were covered nicely in the following response: *"I need to check my phone from time to time (to look at Google Maps or select a specific song or podcast on Spotify). For that I need to stop, take my gloves off and handle that. That interrupts my flow with cycling. Also, due to the low temperatures, my earphones stop working. When that happens, I stop and warm up the jag part so it works again"* (#2). Also, a thicker layer of clothing was seen to cause hindrance, as there was *"a general lack of dexterity due to additional clothing layers"* (#4). Participant #6 had noticed that s/he was looking less at the activity wristband due to the cold weather and for having so much clothes on. Yet another challenge that was mentioned was the dirt covering the lights and reflectors (#4).

As the final question, the participants were asked for ideas or wishes related to technology and winter biking. Heating elements for different places, such as for the handlebars or lock, were suggested by several participants. Some wondered if they should change the current equipment for such that could be better handled with gloves, e.g. to get a bigger key (#1) or a phone holder for the handlebars (#13). A possibility to access the mobile phone while it was inside the winter clothes were also suggested (#6). Generally, durable equipment made specifically for a cold environment was wished for (#11; #15, #16, #76, #77).

4 DISCUSSION AND CONCLUSION

Not surprisingly, the biggest differences in technology use in winter and summer biking was in using lights. This reflects the geographical location of the study participants, who were mostly from Finland. Short days and long polar nights are predominant in the mid-winter, while summers are characterised by short and light nights. On the other hand, it was quite surprising that the mobile phone, earphones and activity tracker usage was commented to be quite similarly common throughout the year. Despite of the practical challenges, the users seem to have a high motivation to use these technologies.

The findings of using technologies in winter biking are much related to the harsh winter weather. The cold requires more from the equipment and people need to invent ways to keep the equipment warm. Most challenges related to two main aspects, which took place due the cold winter weather: the battery drainage, and the extra clothing that was required compared to summer biking. Prior research has also pointed out that one main challenge in winter HCI is with flat batteries [4]. Also the challenges of interacting with a mobile phone [12] and the touch screen usage with gloves has been previously reported. The latter can be addressed with gloves designed for the purpose [6], but with this use context and participant sample, this was not reported as an adopted solution. Not only the touch screen interaction, but also reaching the phone or activity tracker through thick layers of clothes is a challenge. These challenges give useful insight for future concepting of interactive technologies for winter cyclists.

It is worth noting that the legislation in each country has an effect on the technology use. In Finland, it is obligatory to use a helmet, which makes attaching light or other technology to it viable. Moreover, the police fine cyclists riding in the dark without lights (a light at the front and a red light in the back). There can also be restrictions where to attach

the extra equipment, e.g. what is allowed to be carried in the handlebars. These regulations can affect to the design of applications or gadgets for cyclists.

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