Observing the Mobile Music Phenomenon: One in Nine Commuters is Wired

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ABSTRACT
In this study we attempt to quantify the popularity of mobile music device utilization. We present an observational method to study music interaction in the wild and assess the reliability of the method. We apply this method to investigate mobile music device use regionally and globally in Europe, Asia, and North America. Our results show that globally, a stable one ninth of all observed urban commuters is engaged with music gadgets, in Tokyo above the other cities. In depth analysis shows that public displays of music devices are most common late on the working days. A subsample of bicyclists suggests that they utilize music devices even more than the pedestrians, but none of the observed segments is much interacting with the device while in transit. This has several implications for designing ubiquitous music experiences, particularly for modalities utilized in interaction.

ACM Classification Keywords
H5.m. Information interfaces and presentation: Miscellaneous. H.5.5 Sound and Music Computing.

General Terms
Measurement, Experimentation, Human Factors.

Keywords
Music interaction, cultural studies, mobile devices, ubiquity.

1. INTRODUCTION
The status of music as the prominent ubiquitous consumable is hard to deny. By early 2010, iTunes store had sold over 10 billion songs and the general penetration of digital mobile music players among westerners is high. In these market areas, nearly all new cell phones are "music ready" and for instance in Finland, already in 2008 over 40% of people (15-79 years) had a music-enabled phone and 33% also owned a portable audio player[8]. This triumph for portable music is largely attributable to the MP3 digital audio format launched 1999, little more than ten years ago. Together with successful portable players this has created a new vocabulary for music consumption, the culture of iPods and MP3s. However, beyond the sales statistics, it is known that not everyone loves digital music or uses mobile players, even if they possess the hardware and software solutions. Question remains, what do we know about the current, actual use of digital music? To what extent people really utilize the devices in their everyday life in mobile settings?

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In this paper we suggest a method to quantify the mobile music phenomenon and some results acquired using it. The standard video-based observation technique is here modified into a "narrow passage" method which allows gathering data in conditions in which video recordings are not an option. Our data shows stable pattern of small segment (< 15%) of people using mobile music while commuting and several trends, such as time of the day and week, affecting its popularity. We also note that in the observed situations people show very little activity with the device, reminding of the evident constraints for interacting while on move. We discuss the value of these observations for the design of mobile music devices and cultural significance of the phenomenon.

2. PREVIOUS RESEARCH
Research on music consumption can serve multiple interests. It can inform interaction design about realistic use cases and establish design drivers [9]. It also accumulates data about the present digital consumption culture, reflecting the state of technology for documenting technological history. On detail level, use of mobile music devices reveals their acceptability in the task environment under focues.

Studies that have addressed mobile music phenomena usually fall into two categories: surveys and statistics that rely on self-reporting and sales records [5, 10], and ethnography using qualitative methods such as interviews [6, 9]. For instance, Synovate Ltd. [5] recently probed interests for new kind of music services from 8000 respondents around the globe. They claimed that 16% of people globally have used mobile devices to view music videos as well and 8% had paid for mobile music application (an app) whereas 11% had actually bought music online within the last three months. In contrast, almost one third had purchased a physical recording.

The study by Nettamo et alia [6] investigated 12 subjects located in either New York City or in Hong Kong. Nettamo's team studied cross-cultural consumption patterns through extensive interviews and a diary study. They found some differences in both device ecology and usage habits showing how the Americans seemed more individualistic and explorative in their music choices whereas in Asia, the media selections were more socially motivated. To our best knowledge, no studies using observational methodology in the wild exists within the domain of human-

computer interaction (HCI). Therefore the main inspiration for our work is derived from traffic research (see e.g. [2]), which has been using this kind of methodology for decades.

3. METHOD

3.1 Narrow passage observation method

Observations are usually carried out to gather nominal data about the relative popularity of a phenomenon. Their strength as behavioral measures is that they remove biases inherent in self-reporting. This is similar to marketing data (sales figures), which also indicate real actions, not an idealized image of what a respondent believes, remember or wishes to be doing. However, for interaction design, observational data is more valuable than market data, because it informs about real *utilization*, not mere acquisitions.

The sampling rationale of observation method is that the absolute frequencies from a defined sampling population are calculated to estimate the prevalence of the observed parameter in the whole population. For instance, one could classify passing saloon cars as red or non-red. We also need to define the population we are sampling. The challenge is to create a reliable estimate of the proportion of each category. This requires validity (observations are correct) to minimize the number of false positives and negatives in each category. The determination of the desired population is done prior to the investigation.

The next issue concerns how to gather the sample. The ideal method would be real random sampling. This would mean that each and every person in the defined population would have an equal chance to contribute to the sample (once). In practice, this is nearly impossible to achieve in natural conditions. Therefore a convenience sampling that maximizes randomness and minimizes repeated observations of the same subjects is usually applied. Here we suggest a narrow passage observation method for a heavily trafficked location. This method allows a single experimenter to observe all subjects who pass through a count plane. This is done on the field using tally counters for immediate record (see Figure 1). If video recordrings were available, the selection of measurement techniques would naturally be more extensive.

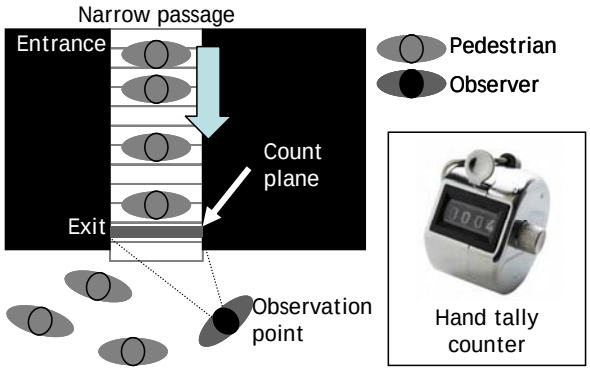

Figure 1. Setup for narrow passage observation and a photo of a hand tally counter.

When this observation method is utilized in short time periods, this achieves the independency criterion of random sampling because people are unlikely to pass by the same point multiple times (even if they might not be easily identified as repeated entries). However, the definition of the population must be adjusted, as this method will only capture those people who could pass by the defined point. After the observation the relative proportions for each observed can be simply calculated.

3.2 Considerations for mobile music

In our present case, we selected public transport hubs as the reference points for our study, indicating that we sampled *urban commuters* as the population of interest. The nominated categories of observation were: *people interacting with music devices*, *people carrying music devices*, and *people without visible mobile music devices.* The appropriate definition of population should include all independent adults and children who are all generally capable of listening to music, but exclude officers on duty, the blind and other special groups.

Observing music devices is largely dependent on the visibility of headphones. This adds to the number of false positives, as some people may not actually be using mobile devices to listen to music. Different mobile phone headsets that provide only a hands-free capacity can also be difficult to differentiate. False negatives may arise if the observer cannot tell a user apart from a non-user because of occlusion due to hair cut, a scarf or similar headdress. To increase validity, these cases must be omitted from the sample, so they are neither counted as users nor as non-users.

3.3 Reliability

We evaluated the re-test reliability of our observation method by doing repeated observations at the same spots at a two-week interval. The results are shown in Figure 2 below and we considered the reliability adequate. This demonstrates that although there was variation, in three out of four comparable measurement points, the 95% confidence intervals for the proportion were overlapping. This suggests that the estimated parameter (proportion of users within population) was reasonably estimated by a single one-hour observation. On the other hand, the re-test reliability might be even the most interesting measure in the context of the ubiquitous music phenomenon because there are factors influencing the target behavior (see discussion).

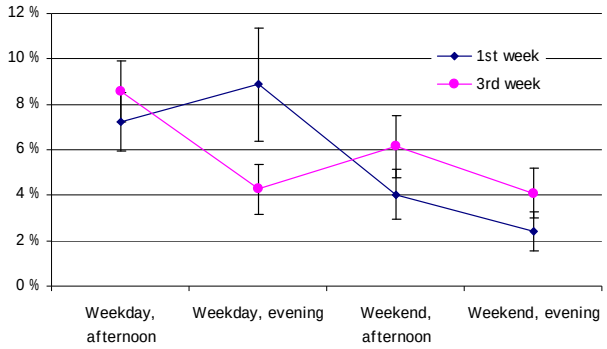

Figure 2. Re-test reliability of the method. Two observations rounds at the same indoors spot. The error bars show 95% confidence interval (CI)

4. STUDY

Goal of this study was to establish reliable estimates about the popularity of mobile music devices in everyday urban life. We selected urban commutation as the point of interest because it presents a daily routine that is ubiquitous in all western societies. Particularly we observed subway, train and underground stations. They provide good opportunities for narrow passage observation at the platform ends of the escalators. Small children travelling with their parents and station employees were excluded.

The selection of commuters is expected to create bias between the nations. Although all selected sites were the urban centers of their respective countries (culturally "central"), the profile of commuting people among the general population varies. In our anthropological perspective, in Japan and UK, the subway is used by a majority of people (both cities additionally have an active taxi network). In The Netherlands and Finland, locals also favor private transports (bicycling and cars). This might be exaggerated in US, although in San Francisco the Bay Area transport are maybe exceptionally popular public transport. Nevertheless, there are probably differences in the relative socio-economical status of the observed people among the global sites, which may reflect in the results but cannot be controlled in a study such as this.

4.1 Finland In-depth Study

We run a study in Helsinki (Finland) during June-July 2009 over a 4-week period. In this study we both validated the observation method and examined the differences in music device employment over different conditions (*indoor* vs. *outdoor*, *weekdays* vs. *weekends*, *afternoons* vs. *evenings*). Single observer collected the sample on two different indoor locations (*Kamppi* and *Rautatieasema* stations) and two outdoor locations heavily used for commutation and recreation (*Hietaniemi* and *Töölönlahti*) next to a marked trail. Each location was observed four times, in the afternoon (4-6pm) and evening (8-9pm), and on both weekdays (Tuesdays) and weekends (Saturdays). For outdoors, all observations were made on good weather conditions. The results were quite consistent showing that people most often utilize these devices during working days and outdoors. On weekends their popularity decreases (see Figure 3). Interestingly, bicyclists were the most active user group, although the difference to pedestrians in outdoor conditions was not significant. The data for bicyclists is combined from the four observations.

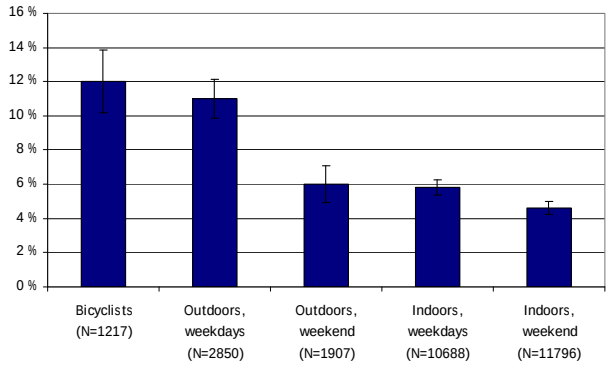

Figure 3. Overall statistics for Finland for the prevalence of music device utilization in different. (symmetric error bars indicate 95% CI).

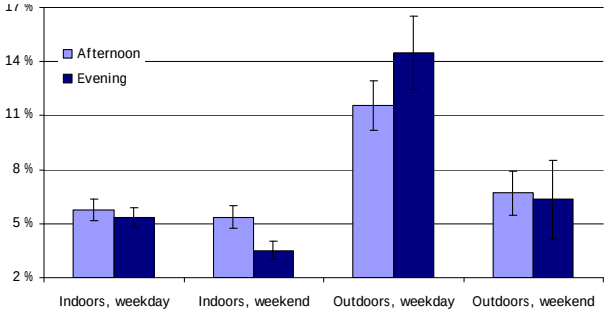

Figure 4. Comparison of music device observations at different times of a day, both in outdoor and indoor conditions, and weekdays and weekends (error bars denote 95% CI).

The daily trends shown in Figure 4 were less pronounced. The use rate is highest outdoors on weekday evenings. The notable differences to the average show in increased evening activity outdoors on weekdays and lack of it during weekends. Indoors there is less variation, but the number of users on weekend evenings is clearly the smallest. Importantly, the trends for indoors and outdoors conditions are dissimilar. In the evenings, utilization increases outdoors, but decreases indoors.

4.2 Global Observations

The data presented here was collected during late summer 2009 (July to September). The observations were made by single trained observer (Author A), lasted for one hour at each site during the afternoon rush hours (4-6 pm) on weekdays. The observed subjects were not videotaped because of the variable security regulations at different transportation systems. The sites in the order of observation were *Helsinki* Rautatieasema subway station (Finland), *Tokyo* subway station Nihombashi Ginza line, Shibuya platform entrance and Kudanshita station Shinjuku-line, Shinjuku platform entrance (Japan), *San Francisco* Embarcadero BART station (US), *London*, Kings Cross St. Pancras subway station (UK), and *Amsterdam* Centraal Metro station (The Netherlands). The overall usage rate was 10.6%. The breakdown of results for each country is displayed in Figure 5 below along with population density of each city. Density and usege rate have a correlation co-efficient of .80 in the present data.

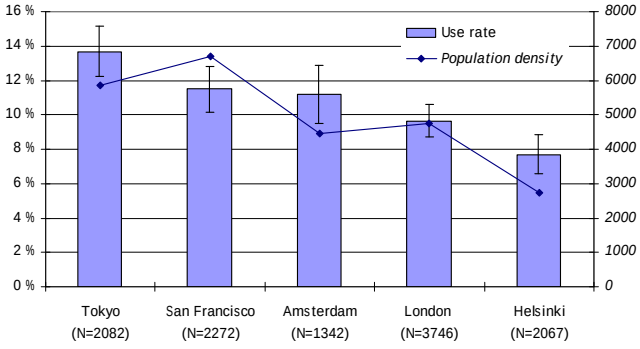

Figure 5. Results from global sites showing the relative proportions of people carrying music devices. N indicates the number of observations, error bars show 95% CI for the proportion. Density expresses number of residents for one square kilometer based on each city entry in Wikipedia.

In Finland and in the global sample, we also tried to pay attention to active *use* of mobile music devices. In the Finnish sample, we found that among all 24116 subjects observed indoors, the proportion of people observed using the device was infinitesimal, only 0.65% of all were observed handling the device. They present 11.7% of all participants of user category, making interaction with music devices quite a rare event. For these reasons, we did not include interaction estimates to the global sample, although observer's impressions elsewhere were similar.

5. DISCUSSION

In this paper we have presented an observational method to study use of mobile audio devices and employed it at public transport stations across the world. Our goal was to quantify the prevalence of mobile music phenomenon in 2009, the concluding year of the decade of iPod and mobile Internet. We found that globally an average of one tenth of all commuters publicly display their mobile music gear. There were differences in the use rate between the cultures and also depending on the time of the day and week.

What do the rates of observed users tell us? First, there are definitely much more devices sold and more potential users than there are active users, even at public transport stations which tend to be rather asocial events in the observed cultural areas. The results from Finland show the variability in utilization rates across contexts. The suggested underuse may reflect the demands of the situation, i.e. maintaining a full awareness of the situation and coping with the flow of commuters. Listening to music might seem too immersive while still navigating, especially with noise blocking headphones. Second, we can see some clear weekly and daily rhythms in the use figures. The indoor and outdoor sites apparently attract different kind of people with different motives. Indoors use is quite constant except for the late weekend when people are probably more social and less busy with their travels.

The third finding is that in each country you can find a certain, quite steady sized segment of mobile music enthusiasts. Japanese are leading the present record probably for several reasons. They are generally considered technology-savvy but they also have the longest roots of mobile music culture. The penetration of the ubiquitous audio technology shows in how older people in Japan have adopted the devices. Of course, in the present study we cannot tell whether these people are just appropriating the music players for other purposes (audio books, podcasts, etc.). Another perspective is that Tokyo has a high population density and thus personal space needs of the commuters are more compromised than in US [3] this might be compensated by more frequent isolation in a private auditory space (cf. [7]), and to cloak users socially from unwanted contacts [4].

The present results call for further investigations on how population density, culture and usage rate interact. Another next step in elaborating the data could be to extend the study into an observational field survey [1] to get more information about mobile music consumption. The lack of qualitative insight is thus the main drawback of the introduced method. The points of concern with the method thus primarily affect validity. This means that the present estimates about the popularity of mobile music are positively biased. The saliency of the music technology users is an issue for the observational research, creating false positives particularly in an environment which does not allow making video recordings of the situation.

Finally, the incidence rate of interaction with the devices raises a question regarding the nature of interaction in the given context. Why are the devices left alone? Users do not interact because they do not want to, they cannot or they prefer doing it elsewhere. This makes music interaction to have different premises than mobile the use of other types of mobile ICT, phones notably require constant attention and contact with the device during the interaction. Therefore we can suggest that the designers adhere to crafting music listening experiences that carry on over time, supporting the intuitive notion with the empirical data of how people really behave in prominent use context. To support interaction in environments such as public transport, future interfaces could support new, non-visual interaction methods. These could enable the users to interact with the music devices with haptic or gesture-based interfaces and aural menus, the senses unoccupied.

6. ACKNOWLEDGMENTS

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