POTENTIALS OF EMBODIED INTERACTIVE TECHNOLOGIES TO ENHANCE MOBILE LISTENING EXPERIENCE IN PUBLIC ENVIRONMENT

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ABSTRACT

POTENTIALS OF EMBODIED INTERACTIVE TECHNOLOGIES TO ENHANCE MOBILE LISTENING EXPERIENCE IN PUBLIC ENVIRONMENT

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Mobile listening can be defined as an evolved form of listening whose history draws back to the introduction of Sony Walkman, which upgraded music players with both privacy and portability. This thesis underlines the challenge of performing such private activity in a shared environment with many people and audio-visual stimuli around. This 'journey' with music becomes more challenging with the interfaces confined into tiny buttons and screens that are scaled down for the sake of portability of the device. Hence, this thesis explores the potentials of embodied interactive technologies to enhance the way users interact with mobile listening media by dealing with the context both as a challenge and an inspiration.

This thesis discusses the relationship between context and user experience. It also draws upon the concept of embodiment which derives from users' physical relationships with the context as aesthetics of interaction does. Then it elaborates different forms of embodied interaction such as tangible, organic, and gestural interfaces.

The fieldwork uncovers mobile listeners' concerns related with user-user, product-product and user-product interactions through Study 1 and Study 2 '*Telling about* and

Living in the Journey' which are conducted as a user journey mapping session and a literal journey with music within the city. With Study 3 'Dreaming about the Journey' it explores the potentials of the embodied elements and actions within the context by analyzing participants' utilization of daily objects and gestures for controlling music in a generative session. This way the thesis shows how aesthetics of interactions can be achieved through embodiment of controls while dealing with the challenges of the context at the same time.

Keywords: Embodied Interaction, User Experience, Mobile Listening, Aesthetics of Interaction

ÖZ

KAMUSAL ALANLARDA MOBİL MÜZİK DİNLEME DENEYİMİNİN ZENGİNLEŞTİRİLMESİNDE FİZİKSEL ETKİLEŞİM TEKNOLOJİLERİNİN SUNDUĞU AVANTAJLAR

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İlk kişisel ve taşınılabilir müzik çalar olan Sony Walkman'in piyasaya sürülmesiyle birlikte hayatımıza giren mobil müzik dinleme deneyimi, müzik dinleme etkinliğinin evrilmiş bir biçimi olarak tanımlanabilir. Bu tez, bu kişisel aktivitenin başka insanlarla paylaşılan ve pek çok görsel ve sesli uyaran içeren bir çevrede nasıl zorlaştığına dikkat çekmektedir. Daha taşınılabilir olmak amacıyla küçülmüş ürünlerin minik tuşlar ve ekranlarla sınırlanmış arayüzleri kullanıcıların yaşadığı bu zorluğu daha da arttırmaktadır. Bu çalışma fiziksel etkileşim teknolojilerinin mobil müzik dinleme deneyiminin zenginleştirilmesi için sunduğu potansiyelleri araştırmaktadır. Bunu yaparken ürünün kullanıldığı bağlamı hem neden olduğu zorluklar ve hem de sunduğu olanaklarla birlikte değerlendirmektedir.

Bu tezde bağlamın kullanıcı deneyimi ile ilişkisi tartışılmaktadır. Çalışma, etkileşim estetiğinde olduğu gibi kullanıcıların bağlamla fiziksel etkileşiminden doğan 'embodied interaction' kavramını detaylı bir şekilde incelemektedir. Buna ek olarak benzer anlayışla geliştirilen fiziksel etkileşim, organik kullanıcı arayüzleri, mimiklerle etkileşim gibi farklı arayüz/etkileşim modelleri de tez kapsamında ele alınmaktadır.

Saha araştırması kapsamında, ilk iki çalışma kullanıcıların, mobil müzik dinleme deneyimlerini anlattıkları bir oturum ve belirli müzik dinleme araçlarını şehirde mobil halde test ettikleri bir seyahat olarak gerçekleştirilmiştir. Bu çalışmalar hareket halinde müzik dinleyen insanların kullanıcı-kullanıcı, ürün-ürün ve kullanıcı-ürün etkileşimi ile ilgili hassasiyetlerine ışık tutmaktadır. Bir yaratıcı oturum olarak organize edilen üçüncü çalışmada ise kullanıcılar müzik dinleme kontrollerini her türlü giyilebilir ve taşınabilir nesneyi ve kendi bedensel hareketlerini kullanarak sergilemişlerdir. Bu çalışma bağlamda var olan her türlü nesne ve hareketin etkileşim tasarımı için nasıl ilham verici olabileceğini göstermektedir. Özetle, bu tez, kullanıcıların bağlamla ilişkilerini de dikkate alarak, kontrollerin fizikselleşmesiyle birlikte kullanıcı-mobil müzik dinleme araçları etkileşiminin nasıl daha estetik hale gelebileceğini ortaya koymaktadır.

Anahtar Kelimeler: Fiziksel etkileşim, Kullanıcı Deneyimi, Mobil Müzik Dinleme, Etkileşim Estetiği

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CHAPTER 1

INTRODUCTION

Music is an embodied part of our daily lives. This embodiment becomes possible through people's access to (recorded) music anytime and anywhere especially after the music has gained mobility with the introduction of portable music players. Since then, the activity of listening transformed more into *mobile listening*.

Mobile listening can be regarded as an evolved form of listening, which grew into a daily practice with the introduction of Sony Walkman in 1979. This was a milestone in terms of bringing privacy into the mobile listening activity which encouraged *listening on-the-go* in public environment. Mobile listening can also be defined as user experience derived from people's interactions with mobile listening media.

Indeed, there are different occasions which combine mobility with listening such as doing sports or driving a car with the company of music. Among these diverse forms of mobile listening activities, this thesis focuses on mobile listening in public environment. The reason for choosing public environment as the context of mobile listening activity is the challenge of doing something personal/private in a public setting.

Public environment creates difficulties for users' interactions with mobile listening products. To illustrate, there are various audio and visual stimuli that detract the attention of mobile listeners who deal with their mobile listening devices at the same time. Another challenging point is that mobile listening activity is integrated into other activities in public environment such as using public transportation orshopping. This complexity results in users' constant switch between their private modes of listening to the 'public mode'.

What also makes this transition and product interactions more problematic is the qualities of product interfaces. Despite the fact that the music players become more 'portable' through miniaturization, they fall short of providing enough fluency in listening-related controls performed in public context of use. These controls have been confined into the little buttons, scaled-down screens with tiny graphic images and texts, which heavily rely on the user's visual modality and require time to deal with.

These challenges encourage one to question if there can be alternative ways of controlling mobile listening media by expanding the interaction area, by making the interactions more harmonious with the mobility of users within public environment, by making use of more tangibility rather than solely depending on graphical user interfaces and by making them more fun and pleasant as well. Considering both tangibility and mobile listening activity together, these questions are furthered as; if the daily wearable and portable objects or the bodily movements that already accompany users in their journey with the music can transform into the means of mobile listening controls. In this regard, the new forms of interfaces utilizing embodied interactive technologies that simply combine physicality and computing become inspiring to answer these questions.

Aim of the Study

As can be understood from earlier exploration of the topic, the aim of this study is *exploring the potentials of embodied interactive technologies to enhance mobile listening experience in public environment*, and it is based on both the problems and possibilities present in the context.

Scope

There can be a variety of ways of enhancing mobile listening experience of users in public environment such as improving the available products' graphic user interfaces, providing alternatives for users' access to music like in the example of online radio applications, or enabling users to share music anytime. Yet, within users' interactions with mobile listening devices, this thesis focuses on enhancing the way users *control* mobile listening media.

These mobile listening media can include any product that enables people to access to music while on-the-go such as MP3 players and smart phones as well as the earphones and headphones. However, this thesis discusses the alternatives for *listening-related* controls that go beyond the controls provided by the interfaces of current portable music players or smart phones. That is why this thesis will put more emphasis on the products that are more specific to the mobile listening activity with different types of interfaces dedicated to listening related controls than the multi-functional products such as smart phones. The option of listening to audiobooks provided by such multi-functional products is not within the scope of this thesis either, since the experience of listening to a text is different than the experience of listening to music.

The listening-related controls are also framed as the *main controls (play/pause, volume up/down* and *skip forward/back)* which are essential to deal with music while on-the-go. However, it also welcomes the insights driven from the research for other type of controls such as shuffling, song selection and forwarding/rewinding.

To sum up, the thesis explores the aesthetic ways of performing these controls (*aesthetics of interaction*) with the use of *embodied interaction* models by not only considering users' interaction with a device (or any means that makes music accessible) but also their interactions with(in) public environment.

Research Questions

The questions that this study will answer can be listed as:

- What is mobile listening (experience) and how has it evolved until today?

- What are the factors influencing current user-product and product-product interactions in mobile music listening experience in public environment?

- In which ways users do prefer to perform listening-related controls and get feedback, while they are on-the-go in public environment?

- What aspects of embodied interactive technologies such as tangible user interfaces and gestural interfaces contribute to the experience of mobile listening considering their appropriateness to the public context of use?
    - In which way our gestures, wearable and portable accessories become integrated to the user interface or regarded as a means of control themselves?
    - What combination of sensorial information/modalities can be used to enhance mobile listening experience?

- What aspects of proposed concepts can inspire the design of the controls of other future mobile devices?

The literature research in the areas of sound studies, user experience, embodied interaction followed by fieldwork are organized to answer the research questions. Consequently, the thesis is structured into six chapters that share the insights driven from both literature and the field.

Chapter 1, *Introduction,* introduces the term *mobile listening*, draws attention to the challenges of mobile listening in public environment, explains the motivation behind the study, presents research aim, scope and research questions, and finally mentions the scope of each chapter of the thesis.

Chapter 2, *Mobile Listening in Public Environment as an Inspiring and Challenging User Experience*, constitutes the first part of the literature review and provides the underlying conceptual frameworks to analyse mobile listening experience in public environment and to discuss if embodied interactive technologies can enhance this experience.

First the chapter touches upon different dimensions of mobile listening experience. In order to answer the research questions related with the meaning and practices attributed to mobile listening, it refers to Cultural Studies literature and questions whether users' way of controlling mobile listening device can be regarded as a cultural practice. The chapter also examines mobile listening as a user experience

and especially draws on the user experience frameworks which put special emphasis on the context of use to be able to analyse mobile listening experience together with the context. Depending on the question of if contextual elements can transform into the aesthetic means of control, the chapter gives the definition of aesthetics of interaction and then discusses the concept of embodied interaction in terms of utilization of physicality in interactive systems. Finally, to be able to discuss what aspects of embodied interactive technologies can enhance mobile listening experience, the chapter touches upon different types embodied interaction models such as tangible, organic, gestural and multi-modal user interfaces.

Chapter 3, *Evolution of Mobile Listening Experience*, focuses on more practical aspects of mobile listening by handling mobile listening devices as essential parts of mobile listening user experience. The chapter tries to explore how this experience has evolved through the advancements in technology and introduction of new products. It also articulates the contemporary trends to understand whether the idea behind this thesis can be integrated to these contemporary approaches.

Chapter 4, *Methodology*, tells about the way the field study is organized. The field work consists of three qualitative studies which try to reveal both challenges and possibilities within the context for mobile listening controls. The chapter provides the underlying user-centred research approaches utilized in the qualitative studies ranging from user journey mapping to generative sessions. The chapter defines the mobile listening activity as a journey accompanied by music and names these studies as 'Telling about the Journey', 'Living in the Journey' and 'Dreaming about the Journey' depending on the type of methods used in each one. Then, it lists the aims of each study together with the details such as the study protocol, participant sampling, and the venue.

Chapter 5, *The Results and Analysis of the Fieldwork*, presents and discusses the results of these three progressive studies. Through the analysis of Study 1, 'Telling about the Journey' and Study 2, 'Living in the Journey', the chapter tries to come up with answers to the research questions regarding the factors influencing current user-product, product-product interactions in mobile music listening experience in public

environment. The analysis of Study 3, 'Dreaming about the Journey', focuses on the question of the possible utilization of the gestures, wearable and portable items which are already embodied in the context.

The final Chapter, *Conclusion*, provides an overview of the highlights of the research and contribution of the study in terms of exploring the potentials of embodied interactive technologies to enhance mobile listening experience. The chapter also presents future prospects of the study by discussing how this thesis can inspire the design of the controls of (other) future mobile devices.

CHAPTER 2

MOBILE LISTENING IN PUBLIC ENVIRONMENT AS AN INSPIRING AND CHALLENGING USER EXPERIENCE

2.1 Introduction

Mobile listening experience in public environment can be analysed with reference to a variety of disciplines. Mobile listening can be regarded as an evolved form of listening that entered into our lives with the introduction of the first personal portable music player Sony Walkman, as a daily urban experience, as an 'inhabitation and personalisation of space with music' (Bull, 2005), and as a user experience derived from the listener's interaction with all industrial products which enable listening 'on-the-go' within the public context of use.

The literature review of this thesis will touch upon all these dimensions. This chapter constitutes the first part of the literature review. The chapter will focus on the conceptual frameworks to explain the *cultural*, *experiential* and *interactional* aspects of mobile listening activity in public environment respectively. The second part of the review will be provided in the following Chapter 3, which will render a more practical analysis of mobile listening by explaining the evolution of (mobile) listening experience through the reflection of technological advancements on mobile listening media.

Regarding the conceptual frameworks that this chapter aims to deal with, first the cultural aspects of mobile listening experience will be explored. In cultural studies literature, especially in the specific field of sound studies, there is a special emphasis on mobile listening devices as contemporary means of reproduction of the sound. There are a variety of social anthropological analyses which explore the cultural meanings of (the use of) mobile listening devices including their specific role in

auditory culture. There is also a great deal of qualitative studies which include insights from interviews with mobile listeners. This review briefly mentions the meanings and practices associated with mobile listening media and activity.

The relationship between mobile listening and public space is also analyzed by explaining how a mobile listener deals with *time* and *space* while and via listening to music. In the literature, temporal (mobility) and spatial (public space) aspects of mobile listening have constituted a great example for theories of production of space. The review will analyze 'space' as a contextual element of user experience as well as its privatization through mobile listening.

The reason why the conceptual foundations of this thesis starts with reference to cultural studies is to set the awareness that when one talks about user-product (or user-user, product-product interactions), he/she does not refer to something different than the practices that shape culture.

Keeping in mind that mobile listening is a daily, cultural and urban experience, this chapter also includes user experience frameworks to provide a multi-dimensional analysis of mobile listening in public environment as a user experience. Since it is a common topic of various disciplines such as human-computer interaction (HCI), industrial design, interaction design, and psychology; there is a variety of user experience frameworks. This variety creates the need of categorization of these frameworks and some of these categorizations will be briefly mentioned throughout this review. The chapter will then discuss other frameworks which put more emphasis on the context as a significant element of user experience.

The scope of this thesis is enhancing mobile listening experience in public environment by aesthetic ways of controlling mobile listening media. Therefore, the special emphasis on the context is not only for the sake of listing qualities of public environment, but also for exploring the potentials of the context in terms of aesthetic interactions. Such exploration requires both the definition of 'aesthetics of interaction' and the perspectives, which try to utilize contextual elements in interface design. The perspectives include 'embodied interaction', 'ubiquitous computing' and

'pervasive computing'. This review mainly refers to Dourish's concept of 'embodied interaction' (2004).

This chapter will also deal with how the concept of 'embodied interaction' is carried to a more practical level with different types of interfaces. Even though they provide different levels of embodiment, these interaction models or types of interfaces mainly include tangible user interfaces, organic user interfaces, full body interactions, gestural interfaces and multi-modal interfaces. All of them will be analyzed together with their embodied interactive technologies, strengths and limitations so that one can able to discuss their applicability to mobile listening activity in public environment.

2.2 The Culture of Mobile Listening

To explore the relationship between culture and mobile listening activity, this section will largely refer to the book *Doing Cultural Studies: The Story of the Sony Walkman* (du Gay et al., 1997) since it selects a mobile listening device, Walkman, as a case to study culture and explain the production of 'shared meanings' and 'social practices' as the basis of our culture.

Walkman was first introduced in 1979. As an innovative product, which offers a novel way of listening to music, it had great impact on our culture and became a part of our 'cultural universe'. In short time it turned out to be an object which everybody had an idea of, and the word 'Walkman' started to refer to a particular type of product -a popular one- in our minds. It found its place in our 'informal social knowledge', which is defined by du Gay et al. (1997) as “a shared, taken for granted knowledge” the source of which is not really well-known. Such presence of a product in our 'know-how' is regarded as the main criterion for being an element of culture (du Gay et al., 1997).

It is also argued that beyond being a part of a culture, Walkman created its own culture by developing distinctive set of meanings and practices. Because Walkman is inevitably associated with particular *social practices* like travelling on train; with music in our ears; with particular *identities*, such as young music lovers; and with

particular types of *images* that come to our minds when someone says Walkman (du Gay et al., 1997).

All the social practices that include a mobile listening device create "significance, meaning and value in cultural life" (du Gay et al., 1997, p.17). For instance, listening to music while travelling in a bus, waiting for a train, or walking in streets signify "the very 'modern' practice of being in two places at once or doing two different things at once" (du Gay et al., 1997, p.17). In other words, the actions we perform as mobile music listener can turn into metaphors that symbolise the modern life.

Du Gay et al. (1997, p.23) claim that:

> each of new media technologies has a particular set of practices associated with it - a way of using them, a set of knowledge, or 'know-how', what is sometimes called social technology.

Therefore, with the application of new technologies to the media of mobile listening, our practices and the meanings associated with or derived from these activities are expected to take new forms. Du Gay et al. define this as reproduction of culture (1997).

Another term developed by du Gay et al. (1997) that is worth mentioning here is "signifying practices". It refers to actions which make sense for us and which have become a part of our taken-for-granted-knowledge. If we do not question someone pushing the play button to listen to music, it means that we can decode the meaning behind this action and place it somewhere in the network of meanings that is shared with other people. Referring to du Gay et al. again, it can be claimed that our interactions with a product are translated into cultural through the meanings we attribute to those interactions.

Du Gay et al.'s analysis perfectly fits to the idea that our interactions with products contribute to the 'experience of meaning' (Desmet & Hekkert, 2006). Therefore, the signification process mentioned here can find its correspondence in user experience frameworks that consider user experience as a sense-making process (Wright et.al, 2007) (See Section 2.4.1 in this chapter.). 'Meanings' and 'identities' as elements of

culture are quite parallel to "identification" or "evocation" characters of product in Hassenzahl's UX model (2007) (See Section 2.4.2 in this chapter.).

2.2.1 Mobility

When mobile listening in public environment is in question, there are two keywords to be explored in detail: *mobility* and *public space*. While mentioning about Walkman and its relation with the culture of late modernity, du Gay et al. (1997) also underline how design of Walkman enables movement and mobility, and how this serves to the creation of identities presented as "self-sufficient urban voyager, ready for all weathers and all circumstances and moving through the city within a self-enclosed, self-imposed bubble of sound" (p.23).

Mobility is the main motivation behind public use. Henceforth, while analysing the relationship between mobile listening and public environment, the following section explores the role of mobility in public space and in public vs. private distinction.

2.2.2 Public Space and Public vs. Private Distinction

The word 'public' is defined as "open to or shared by all the people of an area or country" (Oxford Online Dictionary, 2014). Therefore public environment/space refers to an environment/space shared by people. However, it is more clearly described when it is compared to private space. Like in the case of mobility, being in public environment and the differences between the public and the private domains are also presented as both material and symbolic. The material differences can be exemplified with the physical spaces they are associated with, such as home vs. streets. On the other hand, symbolically, while the public domain is associated with particular 'the formal institutions', 'rules', and 'work'; the private connotes us 'the personal', 'the emotional' and 'the domestic' (du Gay et.al, 1997).

Thus, what Walkman did and other mobile listening devices have been doing is transferring the elements of private listening to the public domain where they are "materially and symbolically *out of space*" (du Gay et.al, 1997, p.116).

Figure 2.1 London Underground poster as a reaction to 'out-of space' activity of mobile listening (Crawford, 2013).

2.3 Mobile listening as an Urban Experience: Mobile Listening and Public Environment

As mentioned above, new technologies sustain and reproduce the cultural practices. Increase in mobility by dematerialization of our music archive with the introduction of mp3 players has motivated users to maintain their mobile listening activity in public environment as a more common practice. This seems to have encouraged researchers in Cultural Studies to investigate the relationship between mobile listening and public space in detail.

In his article "No Dead Air! The iPod and the Culture of Mobile Listening", Bull (2005) presents mobile listening as a 'contemporary urban experience'. The contemporary headphone brands such as 'Urbanears' or headphone collections released with the name 'CitiScape' (Philips, 2014) all make use of the urban context where mobile listening activity is performed.

Bull also claims that mobile listening devices help users to get more control over time and place through "the creation of a privatised auditory bubble" (p.345). Being able to create such personal sound-world enables a mobile listener to inhabit, privatize, individualize and aestheticize the space within which he/she travels (Bull, 2005; Gram, 2013).

If we look closer to the 'public vs. private' binary, we can refer to the terms 'doors', 'bridges' and 'interchanges' of Thibaud (2003) to explain how mobile listening connects and separates the public and the private.

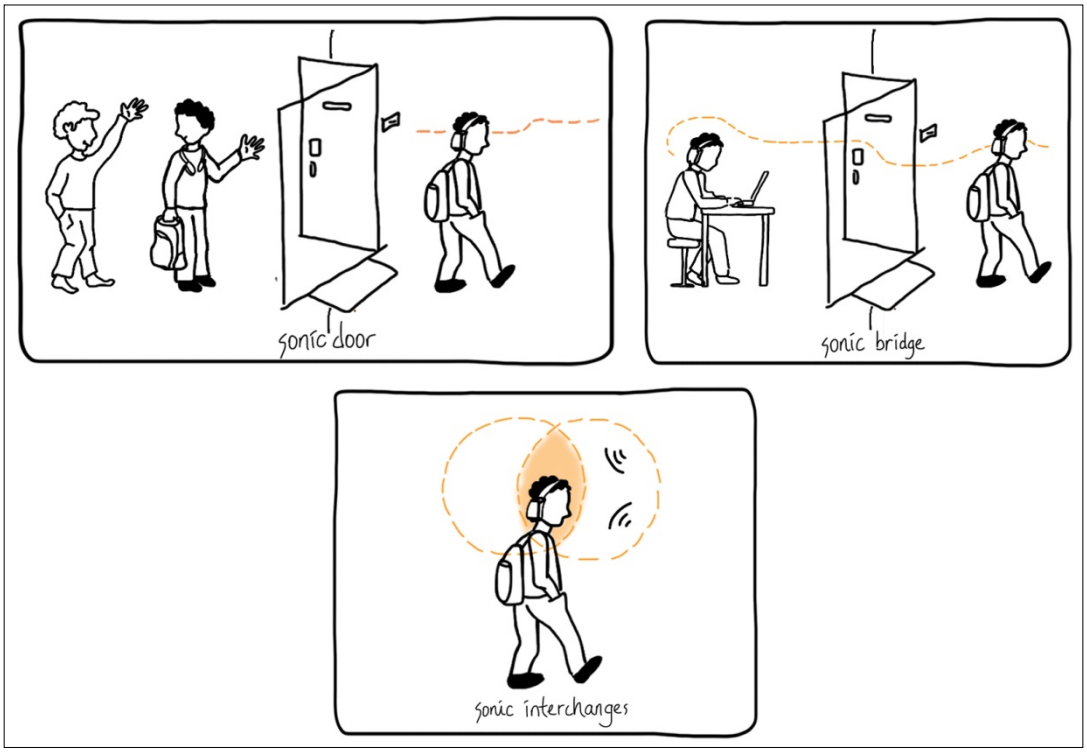


Figure 2.2 Representation of Thibaud's 'sonic door', 'sonic bridge' and 'sonic interchange' (2003) by the author

'Doors' are presented as transitional places to access to public space. Thibaud (2003) claims that getting out of the house by closing the door is 'synonymous' with the start of user's private listening and his/her journey within the city. Actually it is all about finding a moment when someone no longer needs to be 'sonically accessible' in a domestic setting, which defines the beginning of mobile listening activity. Thibaud (2003) names this threshold as 'sonic door' (See Figure 2.2).

Being able to listen to the same song at home and outside constructs a link between domestic and public spaces. 'Sonic bridges' (Figure 2.2) established by headphones enable mobile listeners to blend borders between two spaces through music, which is called as "phonic deterritorialization of urban environment" (Thibaud, 2003).

"Hear" is a very defenceless sense (Bull, 2005). We can achieve not to see something by simply closing our eyes; however, such prevention from audio stimuli is pretty harder (Bull, 2005). Therefore, referring to Bull (2005) it can be claimed that digital mobile music players empower the ears of its users by letting them decide what they really want to hear thanks to their portable digital music collection. However, the term "interchange" (Figure 2.2) is related with another type of empowerment of our ears: our ability to adjust the sound volume of our mobile listening device depending on the sonic structure of the context. Thibaud (2003) claims that it is about maintaining a balance between foreground and background sound sources. In particular conditions, background sounds can become foreground with or without user's control (Thibaud, 2003). The possibility of such "sonic interchange" increases with the user's mobility.

Figure 2.3 Sonic bridges and interchanges through Google Glass on the road of a new track (Glass Explorer Program, 2014).

In one of the "Explorer Stories" videos of Google Glass (Figure 2.3), DJ Young exemplifies how these 'sonic bridges' and 'interchanges' offer inspirations for a new track (http://www.youtube.com/watch?v=l5XoAkOuWdM). After learning the name of a song playing in a Mexican restaurant, Young continues to listen to the same

song via Google Glass (bridging the restaurant with streets) while walking on the streets full with the helicopter sounds at the background. Inspired by the sonic interchanges he experienced that day, he mixes the Mexican song with helicopter-like sounds in his new track.

It is not just the variety of songs or control over the sound volume that helps users to manage the interface between themselves and public environment. Beyond these audio controls, the music player and headphones can be the means of visual communication as well. Bull (2005) states that mobile listening can turn into a tactic to lessen the possibility of social interaction with others. Even though the analysis of the fieldwork will be given in the following Chapters of this thesis; the remark made by a participant is worth mentioning here. The participant argues that "*headphones give the message of 'I won't hear you, I am focused on what I am listening' to the others*" that aptly illustrates the visual detachment of mobile listeners from their surroundings.

Whatever tactic a mobile listener uses not to ruin the 'auditory bubble' he/she creates through the music, the dynamics of public environment may require switches between the personal mode of listening and the public mode (Heye & Lamont, 2010) as illustrated in Figure 2.4.

Figure 2.4 Representation of switching between the auditory bubble and public mode by the author

While listening to music on-the-go, users find themselves in two 'simultaneous sonic-worlds'; the one created by the music player and the other by streets (Thibaud, 2003). This converging point where the users stand is called as 'interphonic knot' by Thibaud (2003). In this illustration the mobile listener can no longer sustain his

'auditory bubble' and has to give priority to one of these sound-worlds in this interphonic knot when he is exposed to a sudden audio stimulus. The reason of such prioritization can be a visual stimulus as well; when the listener cannot divide his/her attention to multiple modalities. Therefore, our search for aesthetics of interaction of mobile listening devices will also include the seamless and subtle transitions between these modes.

So far, the present sections touched upon the meanings and signifying practices of mobile listening that shape the culture of mobile listening, the material and symbolic meanings of mobility and the public vs. private domains as well as the role of new technologies to reproduce culture. Then the focus is shifted on the relationship between mobile listening and the urban environment; inhabitation of space via music; creation of personal sound-world, which is called 'auditory bubble', listener's ability to deal with his/her environment through the terms: sonic door, sonic bridges and sonic interchanges; users' levels of autonomy in inter-phonic knots, mobile listening devices as visual components and finally the necessity of switching between privatized mode of listening and the alert public mode.

Having discussed how this daily and cultural experience is analysed by social scientists, this part has already given some references to user experience frameworks especially while discussing the meaning derived from the practices (which includes user activities, user-product/user-user interactions and so on) influenced by new media technologies. Now the chapter will look deeper into the multiple dimensions of user experience to analyse mobile listening as a user experience.

2.4 Mobile Listening as a User Experience

In this research mobile listening experience is considered as a 'user experience' which -as a term- differs from mere 'experience', since it includes a product, service or a system to be experienced by people (Roto, 2006). In that sense it can be claimed that what makes mobile listening a user experience is the media that is utilized for listening on-the-go. The media can be provided in any form, but can be listened on personal music players, earphones, headphones and other mobile devices with music playing features within today's technology.

2.4.1 An Overview of User Experience Models

To analyse mobile music listening in public environment as a user experience (UX), it is necessary to briefly look at how user experience has been conceptualized to reflect its multi-faceted character. There are various definitions, models and frameworks of user/product experience influenced by different disciplines, perspectives and the multi-dimensional nature of experience. Regarding this variety, there also have been attempts to classify the models and frameworks of UX created so far. This section draws upon the two main examples of the UX classifications made in the literature. The first one is Forlizzi and Battarbee's (2004) overview, which categorizes UX models as "product-centered, user-centered and interaction-centered models" (p. 262). Then comes Hassenzahl & Tractinsky's (2006) categorization based on facets of user experience including beyond the instrumental, emotion and affect, and the experiential.

According to Forlizzi and Batterbee (2004), *product centered models* mainly set a list of criteria to be taken into account while designing and evaluating products and services regarding particular types of experiences.

User-centered models, on the other hand, try to understand the reasons behind people's actions and how they affect this interaction between the user and the product (Forlizzi and Batterbee, 2004). To illustrate, Forlizzi and Batterbee (2004) mention about Hassenzahl's (2003) approach which classifies the modes of users while interacting with a product as *goal* and *action* mode. In goal mode the user focuses on completing a task in an efficient way, while action mode is more spontaneous and explorative (Hassenzahl, 2003).

Lastly, *interaction-centered models* (Forlizzi and Batterbee, 2004) focus on the relationship between user and the product and also how a product creates a link between designer and the user. Forlizzi and Batterbee (2004) claim that some of these interaction-centered models are highly inspired from John Dewey's approach that touches upon "qualitative and definitive aspects of experience" (2004, p.262). Wright et al. (2008) also refer to Dewey (1925), who defines experience as an "unanalyzed totality" of the subject and the object or act and material. In their

definition of 'aesthetic experience', Wright and McCarthy (2008) refer to those aspects in different words while mentioning the integration of the sensory and the intellectual faculties. Wright et al. (2008) present user experience as a sense making process where "compositional, sensory, emotional and spatio-temporal threads contribute to actions that create meaning" and it constitutes one of the examples of interaction-centered UX models (Forlizzi and Batterbee, 2004, p. 262). This categorization developed by Forlizzi and Battarbee mainly involves two main actors (user-product) and the relationship between the two; therefore the analysis itself can be considered as a basic model of UX.

However; it is not the only attempt to classify user experience frameworks and models. In their article titled "User experience - a research agenda" Hassenzahl and Tractinsky (2006) put forward an analysis capable of reflecting the multi-dimensional nature of these models. They discuss different facets of user experience that are emphasized in different user experience models as can be seen in Figure 2.5.

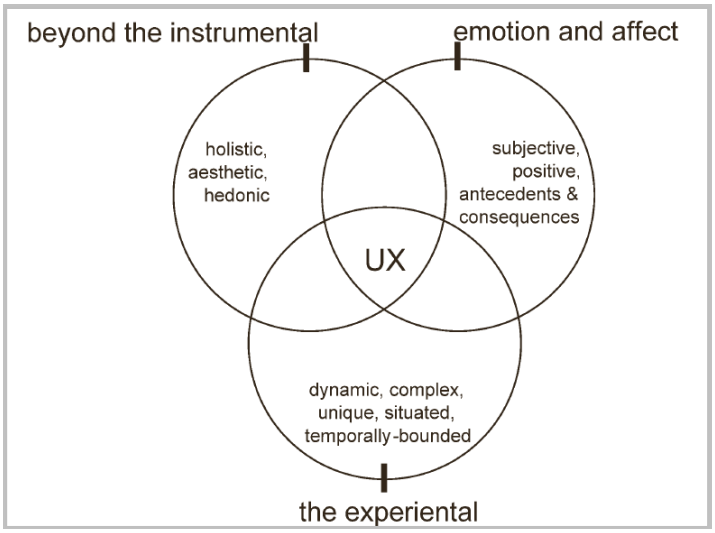


Figure 2.5 The facets of user experience (Hassenzahl and Tractinsky, 2006)

Beyond the instrumental indeed could be the key phrase that separates usability from user experience. This category mainly focuses on the hedonic characters (stimulation, evocation, identification) of products rather than the pragmatic ones (utility, usability). The term aesthetics of interaction and aesthetic experience

(Overbeeke & Wensween, 2003; Desmet& Hekkert, 2007; Wright et. al, 2008) can be also analysed within the *beyond the instrumental* facet of user experience.

As can be seen in Figure 2.5 another facet of UX is indicated as *emotion and affect*. Experience is expected to be affective, since it evokes particular emotions. Therefore, the terms like affective computing aims to draw attention to emotion and affect while designing human-computer interaction. Whereas early attempts to apply such perspective to HCI mainly aims to lessen the negative emotions caused by the interactive products or systems, later examples (Desmet et al., 2001) consider affect as a design goal and try to evoke positive emotions through products (Hassenzahl and Tractinsky, 2006). Hassenzahl and Tractinsky (2006) also mention about other approaches that argue for the influence of positive emotions triggered by the product on the perceived usability. Having overviewed the arguments on emotional and/or affective aspects of user experience, Hassenzahl and Tractinsky come up with two categories: the approaches considering affect as a consequence of our product experience and the ones considering affect as a factor that enables user to evaluate and make judgments about a product (2006).

The experiential facets of UX refer to 'situatedness' and the 'temporality' of the experience. Experience highly depends on the product and user's state of mind; how he/she feels, what he/she expects from the product and the active goal he/she wants to achieve through the use of the product. In experiential perspective these elements are claimed to be interrelated, having influence on each other as well as affecting actual user experience as a result of this process (Hassenzahl and Tractinsky, 2006).

Forlizzi and Batterbee's differentiation between "an experience" and "experience" is regarded as a further step to underline situatedness and temporality of user experience. While "an experience" with a start and end is something unique; experience is defined as "a constant stream of 'self-talk' " by Forlizzi and Battarbee (2004), with an emphasis on subjective and dynamic character of UX (cited in (Hassenzahl and Tractinsky, 2006, p. 94).

With regard to this complexity, they discuss if we can control all these dimensions to design an experience or the only thing possible is designing for an experience. It is also claimed that positive experience should be provided by product features independent of the contextual aspects- that is the "ubiquity of experience". Hassenzahl and Tractinsky (2006) argue that this idea may require questioning the fundamental HCI perspective which expects interactive products to blend into the context. However, as one of the focal point of this thesis, 'context' should be handled with the opportunities it provides as well as its limitations; which will be discussed further. In other words, the complexity of the context could be seen as a burden in creating positive experience; but it could be the source of inspiration as well.

2.4.2 User Experience and the Context of Use

Analysis of mobile listening in public environment necessitates definitions and frameworks of user experience putting special emphasis on the context of use. Having discussed the *experiential* aspects of user experience, this section offers definitions of context and the frameworks that include context/situation as an active element.

Context is defined by Dey (2001, p.5) as

> ...any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves.

This definition is useful to understand that context can be related with each element or 'entity' of interaction. It tries to answer the questions of who, where, what and how in order to get information for the relevant entities of a particular interaction. However, Dourish (2004) criticizes such definitions which reduce context to a form of information and adds that the relevancy of the information cannot be determined in advance. For Dourish, context is not the matter of 'representation' of the situation; it is "a relational property between objects or activities" (2004, p.5). This way context is redefined as an "interactional problem" rather than a "representational one". This interactional problem includes the fact that context is not separate from

activities or it is not stable; it rather stems from activities and it is particular to each activity.

According to this approach, in this research, public environment cannot be regarded as a context itself without giving reference to the mobile listening activity. Because public environment does not influence listening on-the-go as in same way as it influences other activities. That means that one should consider the dynamics of the context together with the dynamics of the activity. While explaining contextual user experience, Obrist et al. (2010) mention that the bond between user experience and the context can be considered as a 'matrix' of UX factors versus contextual factors.

The examples of UX frameworks that include context as a part of user experience now follow.

Hassenzahl and Tractinsky (2006, p. 95) define user experience (UX) as:

> A consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.).

Roto (2006), referring to this definition, presents a diagram that paraphrases all these dimensions as can be seen in Figure 2.6.

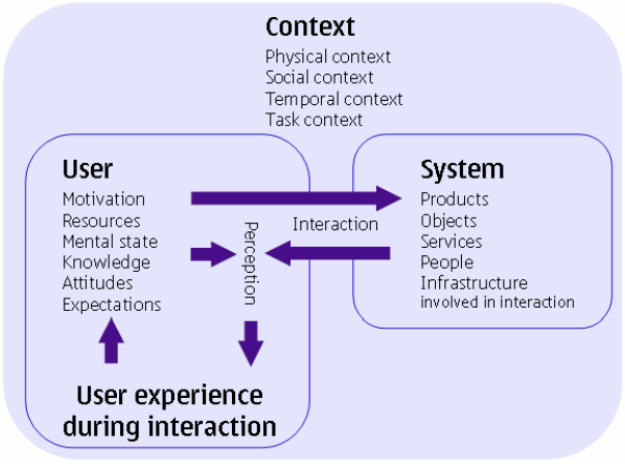


Figure 2.6 User experience during interaction (Roto, 2006)

As Roto reflects user's interaction with a 'system', he feels the need to include the objects, services, people and infrastructure within that system (See Figure 2.6). However; even if we are to reconstruct this diagram focusing merely on user-'product' interaction we should consider the presence of other objects, services and people. All of them are actually involved in "physical, social, temporal and task context" (Roto, 2006, p.2) within the environment in which interaction occurs. In other words user-product interaction can be considered as an intersection of other interactions happening within the context.

Roto (2006) does not mention what these four types of context exactly refer to. However, it is not hard to assume that physical context is related with spatial and tangible characteristics of the situation, while social context denotes the presence of other people. Furthermore, it is the temporal context which makes an interaction occasional. Task context, on the other hand, is the context shaped by the requirements of the task.

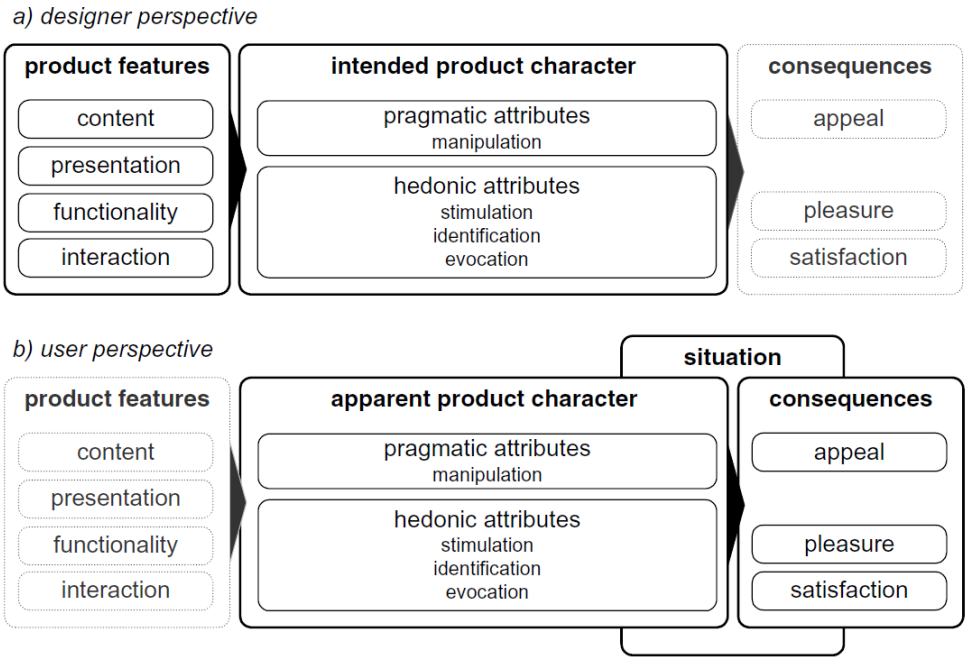


Figure 2.7 Hassenzahl's user experience model (2003).

The diagram in Figure 2.6 includes sub-phrases for the internal state of the user; but what is missing in this diagram is the "characteristics of the designed system" (See

the quoted definition of Hassenzahl & Tractinsky, 2006, p. 95.). In his own model, Hassenzahl (2003) gets into detail about what the characteristics of a product would be, how these characteristics can be classified and finally what the reflection of these characteristics on user's emotional state would be.

Hassenzahl (2003) divides product characters into two as pragmatic characters and hedonic characters. While the pragmatic characters are more about utility and usability; hedonic characters are defined as "stimulation", "identification" (communicating an identity) and "evocation" (provoking memories). Within this cause and effect relationship, Hassenzahl includes "situation" as a factor which directly influences user's interpretation of these pragmatic and hedonic product characters. Whether the product appeals to user, or contributes to pleasure and satisfaction of the user as a result of these interpretations is called as 'consequences' (2003).

Hassenzahl (2003) also tries to bring a solution to the unpredictability of the consequences which depends on the user's changing psychological state by defining two modes of users. As we mentioned above, under user-centered models, while in goal mode user tries to complete a task in an efficient way; in action mode the user wants to enjoy and explore the products without any concern for efficiency. For example, we can say that in goal mode, the appreciation of the product's pragmatic character may increase.

The reason why Hassenzahl's model is involved in this section dealing with the relationship between user experience and the context of use is that it shows the influence of 'situation' on overall experience. Therefore, in case of mobile listening, even if the context of use is defined as public environment, the term 'situation' suggests awareness about the set of temporal circumstances within this context. Yet, in Hassenzahl's model, 'situation' refers solely to the situation of *the user* (action and goal modes). This makes us question the other variables (temporal/non-temporal) in the context of use.

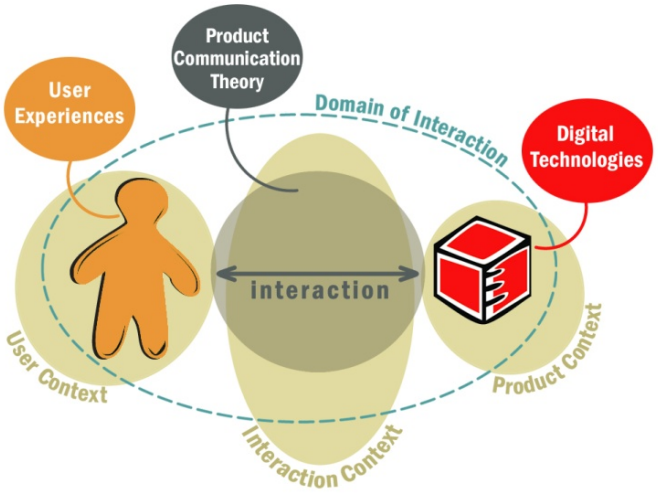


Figure 2.8 Domain of Interaction (Şener & Pedgley, 2014).

The 'domains of interaction' diagram proposed by Şener and Pedgley (2014) (See Figure 2.8) shows how these variables are grouped in "user context", "interaction context and product context" and together form the domain of interaction. Accordingly, "user context" refers to users' "demographics, knowledge, values, physical and cognitive state". This entails users' past experiences. "Product context" denotes the extrinsic rather than intrinsic-physical-properties of a product (Şener & Pedgley, 2014). It is the additional information attributed to a product such as brand value, packaging and so on. Apart from these intrinsic properties, the environment and infrastructure affecting the use of the product are also considered within the product context (Şener & Pedgley, 2014). Particular conditions necessary for functioning of the product such as electricity or Wi-Fi connection can be given as examples of product context (Şener & Pedgley, 2014). Finally, “interaction context” corresponds to the situation (location, cultural, social and political) in which interaction takes place. Public vs. private distinction in product use and the effects of other people's presence can be regarded as interaction context (Şener & Pedgley, 2014).

If a user-product interaction defines its domain of interaction, the domains of other user-product, product-product and user-user (social) interactions may intersect with this domain. We see such expansion in domain of interaction in Forlizzi's Product Ecology framework (2007) with the inclusion of social relations between people. The

framework provides an approach to understand how products evoke social behaviour. To do so, as can be seen in the Figure 2.9, the framework involves the product with other surrounding products as a part of a system; the people with their individual way of interpreting the product and the environment where product is used which has a particular "physical structure, norms and routines" (p. 12). All these elements listed as "product, system of products, person/people, roles, and place" are called by Forlizzi as "product ecology factors" (2006, p. 16).

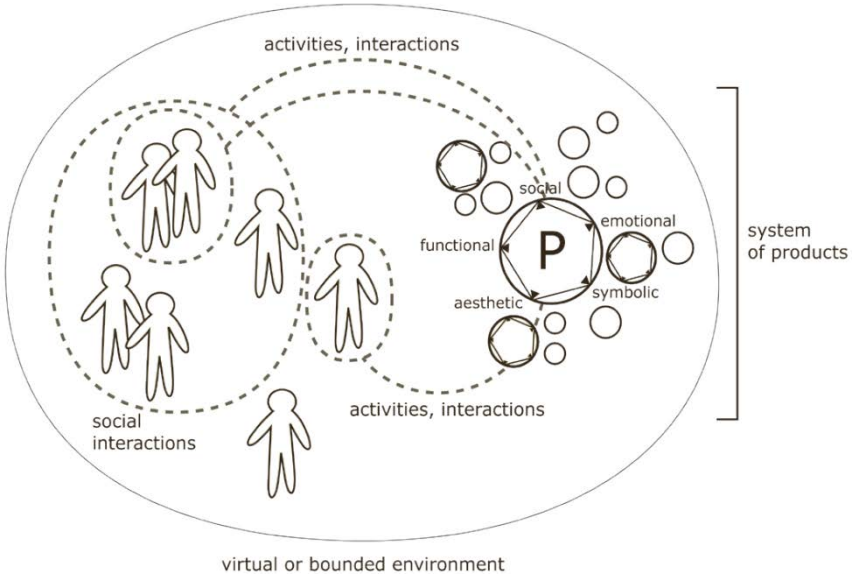


Figure 2.9 Product Ecology (Folizzi, 2007).

As many other UX researchers who appropriate the theories of social science to conceptualize user experience, Forlizzi also bases her framework on social ecology theory. Basically social ecology tries to investigate the dynamic social relationships and how the context shapes those relations. Forlizzi (2007) makes an overview of the main arguments of social ecology. Some of these arguments include the affects of physical environment on human experience, the importance of taking the complexity and multi-dimensionality of the these environmental factors into account and the necessity of considering people living/using the environment in terms of different levels including both individuals and larger groups of people.

Forlizzi (2007) shows the reflections of these arguments on Product Ecology Framework with the diagram in Figure 2.9. We can clearly see that how small and

bigger groups of people as well as individuals interact with each other (social interactions) and how they also interact with the same product or different products (activities, interaction) within a "virtual and bounded environment". All products which are parts of these activities and interactions have "functional, aesthetic, social, emotional and symbolic" dimensions.

Forlizzi's special emphasis on place as one of the product ecology factors becomes more meaningful in the case of mobile listening in public environment. The term 'place' here refers to both physical and social context. Dourish (2004) argues that the difference between space and place can be explained by the difference between the physical and the social; however he does not ignore the affects of spatial arrangements on social behaviours. There are various examples in the literature showing the role that physical context plays in social interactions. Kraut et al. (1990) show that shared physical environments inevitably encourage 'informal social communication' (cited in Forlizzi, 2007). Furthermore, it is also claimed that behavioural norms influenced by the physical structure of an environment can both enable and limit particular types of interactions. This clearly explains how listening can become more challenging in public environment.

Wright et al. (2008, p.4) also draw attention to context related aspects of user experience by providing a "holistic approach"-as they call it- which conceptualizes experience as "a braid made up of four intertwining threads: the sensual, the emotional, the compositional and the spatio-temporal". They introduce this approach as one of the user experience perspectives that goes 'beyond the instrumental' by underlining the sensual and emotional threads. Inclusion of the spatio-temporal and compositional threads as well shows us how our aesthetic and emotional relationship with products is interrelated with the context.

While illustrating the spatio-temporal thread, Wright et al. (2008) talk about the difference between public and private space; "comfort zones and boundaries between self and the other, or between present and future" (p.5). Experience is highly dependent on time and space; therefore, what brings particularity or uniqueness to an experience are the spatio-temporal threads.

The compositional thread is about our relationship between the parts and the wholes of the product/service/system that we interact with. They also relate the compositional thread with "control and agency", because the level of autonomy in interaction depends on how well these multiple parts are combined. Since we talk about the composition of the parts as a mean of aesthetics, it also affects the aesthetic experience of a product.

The word compositional in Wright et al.'s (2008) model seems to refer to the composition of the parts of the product itself. However, the context of use can be also regarded as a composition if we consider the user's simultaneous interaction with other people and his/her environment together with a specific product. This approach can easily lead us to investigate the product-product, user-user interactions in an environment and their influence on the way we experience a product. Therefore, if we give an example from a personal music player, in terms of composition; we can discuss the layout of controls, the way we navigate on the screen, the feel and look of the particular parts/buttons, the connection detail of the earphone jack and combination of all these details. However, if we handle the music player as a part of a composition, it becomes more intertwined with the spatio-temporal threads. Then, we start to analyse the relations of music player with our clothes and our body; our relations with other people and the changes in our interaction brought by the increase of the number of compositional elements (e.g. when the public place gets more crowded) and so on.

To sum up, some of the UX models help us to understand the whole picture of user experience with all actors and factors, while the others deliberately crop it and look into the details. For instance, in Product Ecology Framework of Forlizzi (Figure 2.9) one can see the relationship between different domains of interaction. However; to reflect on the role of each element of interaction, it is necessary to pick one of these domains and discuss the context of user, product and interaction as in the diagram of "Domain of Interaction" which intentionally focuses solely on user-product interactions (Şener & Pedgley, 2014). Roto (2006), on the other hand, prefers to frame his model (Figure 2.6) with user-system interaction instead of focusing on user-product interaction by differentiating the people and the objects within the

system from other people and objects present in the context. By zooming in and out, the analysis of literature presented so far has tried to demonstrate diverse focus points of each model which does not necessarily aim at completing the 'missing parts' of the others.

2.5 Aesthetics of Interaction

The reason why this chapter largely draws on the contextual aspects of user experience is the idea that the parts of the context can be utilized as a means of *aesthetic interaction*. Before mentioning the particular interaction styles deriving from such idea, the concepts 'aesthetics of interaction' and 'aesthetic experience' will be briefly explained.

The notion of aesthetics has been associated with the visual appearance of the products. However, when user-product interaction is considered, it can be seen that aesthetics is not only limited to how users visually perceive the products and be pleased with them, but also how they feel them through their all senses. Hence, it is essential to propose a new terminology to describe the beauty of our physical relationship with products. This explains the reason behind the emergence of the terms of 'aesthetics of interaction' and 'aesthetic experience'.

Aesthetic experience has already been mentioned under 'beyond the instrumental' category of Hassenzahl and Tractinsky's (2006) classification of user experience models. Here, the aim is not to answer functional needs of users but being able to "delight user's one or more sensory modalities" (Desmet & Hekkert, 2007, p.59). Therefore, aesthetics of interaction (as part of aesthetic experience) can be related with the product sounds, its tactile, kinaesthetic and even olfactory properties as well as its visual aesthetics (Desmet & Hekkert, 2007; Overbeeke & Wensveen, 2003).

There are other corresponding terms to aesthetics of interaction such as "pragmatist aesthetics" developed by Peterson et al. (2004) implying 'aesthetics of use'. They claim that pragmatist aesthetics approach is based on three central aspects of aesthetics which are enumerated as "the socio-cultural approach to aesthetics,

designing for mind and body, and instrumentality of aesthetics" (Peterson et al., 2004, p.270).

Referring to Dewey (1987), Peterson et al. (2004) argue that the notion of aesthetics is embedded in material world and structured by socio-cultural factors. They claim that one cannot talk about an autonomous aesthetics of a product; rather it emerges with the appropriation of the product by users (Peterson et al., 2004). Secondly, they argue that aesthetic experience includes both our intellectual and bodily activities (although some models separate the intellectual/sense-making process as another part of user experience as in the example of "experience of meaning" (Desmet & Hekkert, 2007).). Finally, they criticize the understanding of aesthetics as an 'added value' and underline the significance of considering aesthetics as a significant element of user-product interaction. This approach is valuable to understand how experience of pragmatist aesthetics requires a physical encounter/interaction; in other words how it stems from the context and use.

In their special issue editorial, *Aesthetics of Interaction,* Hummels and Overbeeke (2010, p.2) set their view on aesthetics of interaction in several bullet points one of which ends with "Our bodies are mechanical: all interaction is essentially mechanical, or tangible. We have few other ways to interact with the world. Therefore embodiment is essential." Having discussed how aesthetics is embedded in our daily use of products, the following section will articulate the term "embodied interaction" developed by Paul Dourish (2004).

2.6 Embodied Interaction

Embodied interaction is an approach which takes embodiment as a key term in design and the analysis of interaction as a whole phenomenon. Embodiment is defined by Dourish (2004, p. 100) as "possessing and acting through a physical manifestation in the world". The significance of the term embodiment for designing interactions derives from the idea that our experiences emerge from our *physical* and *social* presence and actions in this world Dourish (2004).

While constructing his argument around the notion of embodiment, Dourish (2004) actually refers to the 20th century thought-phenomenology. The main concern of

phenomenology is the way we perceive, experience and act in the world. Phenomenologists proposed that people can make sense of things and develop abstract world models only through being and acting.

One may question how Dourish contributes to the former understanding of interaction by taking 'embodiment' into account. First of all, considering embodiment in interaction leads designers to put more emphasis on the setting in which interaction occurs. If only one can understand the activities embodied in a setting, he or she can offer particular form of computing which fits best to that setting (Dourish, 2004). Secondly, the focus on setting requires conducting field studies which enable the researcher's encounter with the real actors of the interaction instead of creating abstract representations of users or the context in mind (Dourish, 2004). The methodology of this thesis-which is explained in following chapter in detail-shares a similar principle by involving research techniques which reflect real phenomenon with real context of use, real users and real products. Finally, the relevance of embodiment to the design of interactions is justified by the idea that daily objects can provide new dimensions to the interaction via their direct embodiment in our practices. To exemplify what these dimensions can be, Dourish (2004) talks about paper medical record cards used for each patient in a hospital. It is mentioned that wear and tear of the card can give clues about how long it is used or the form of writing can enable us to guess which physician applied the treatment. Therefore, aside from being a representational medium for patients, a medical card directly participates in the interaction (Dourish, 2004). This example can be translated into the case of mobile listening in public environment: we can detect mostly used controls by looking at the changes on the surface of MP3 player, utilize our t-shirts as earphone holders, prefer headphones over earphones in cold weather, make use of an accidental scratch on the surface as a reference point for navigating on the device better.

2.6.1 Embodiment in Tangible and Social Computing

Dourish (2004) believes that tangible and social computing both derive from embodiment by utilizing people's familiarity with everyday world with full of physical and social interactions. As stated by him, it is impossible to avoid from the

physical facts that we experience every day through our interactions with physical objects that we hold, wear, sit on, push; and through the results of physical phenomena such as "gravity, inertia, mass and friction" (p.99). Therefore, in tangible computing the role of physicality is more than being a metaphor in digital platforms; it directly uses real-time physical phenomena. This will be further explained under the Section 2.7.1 'Tangible User Interfaces' .

Embodiment is also applicable to our interactions with other people in a socially constructed world. These social interactions also make us attribute social meanings to the elements of our daily life such as family, children and technology so on. This shows how the physical and the social are intertwined with each other. Hence, what social computing tries to do is applying sociological methods and reasoning to design and development of interactive systems (Dourish, 2004). The significance of including a sociological perspective becomes clear when we consider the 'context' in which computation will be used. Dourish (2004) highlights its importance by claiming that it is the context that makes us understand the interactive products are the parts of a "richer fabric of relationships between people, institutions and practices"(p.56).

Aside from 'embodied interaction' there are other concepts that draw attention to the embodiment of computing to daily objects and practices as well. In the concept of 'ubiquitous computing' (Weiser, 1993) or 'everyware' (Greenfield, 2006) computation is not something specific to particular digital products that we assign for computational tasks, rather it is embedded into every piece of our daily lives. The term 'pervasive computing' (Ark & Seller, 1999) is almost synonymous with ubiquitous computing. It is defined as spread of computing throughout the environment, which contributes to the mobility of users, availability of information and easier communication among people. Computation embedded in a particular object or a space makes this object or space more aware of its context and helps them act accordingly. Dey (2001) calls this as 'context aware computing' and defines the term as computation which provides relevant information or service to its users depending on their task.

Concerning mobile listening in public environment, one can talk about the possible transformation of mobile objects (objects which gain mobility through portability or wearability such as our clothes and accessories) into the physical controls of mobile listening devices. They may even convert into the mobile listening devices themselves.

The concepts or terms that somehow correspond to 'embodied interaction' can easily be multiplied (such as ambient intelligence and internet of things). Despite this multiplicity, most of them share similar prominent issues; which Dourish (2004) categorizes as the relationship between physical form and activity and the sensitivity of computing to the environment.

2.6.2 The Notion of 'Place' and the Embodied Interaction

The above-mentioned emphasis on context points out the relationship between place and embodied interaction. While discussing the importance of place in Product Ecology Framework, the difference between space and place is already articulated. Dourish (2004) differentiates 'place' from 'space' and defines it as a space shaped by social interactions.

Accordingly, the place does not refer to a physical structure; instead it is where the activities take *place* (Dourish, 2004). Here space appears as the main reason behind the emergence of practices. However, it is a two-way relationship in the sense that practices may affect spatial arrangements as well (Dourish, 2004). These arrangements are generally presented as the alterations made in large indoor or outdoor settings. Yet, spatial configurations cannot be confined to the alterations made in large spaces. This study argues that the arrangements of wearable and portable objects involved in the activities while travelling with music also constitute a type of spatial configurations. The last point to be considered in terms of place with regards to embodied interaction is how the notion of place relies on particular communities or practices (Dourish, 2004). Some settings can be perceived differently by different communities (Dourish, 2004).

2.7 Different Forms of Embodied Interaction

Under the title of 'Aesthetics of Interaction' it is mentioned that our notion of aesthetics is formed through our encounter with the world. The overview of embodied interaction approach above encourages us to further investigate 'if can we make use of objects, settings and bodily movements which are already embodied in our physical and social practices as a means of interaction and its aesthetics'. Next part will briefly touch upon different forms of interaction which try to tackle this question. The following analysis will examine how these different forms of interactions are conceptualized, how they utilize technologies and what strengths and limitations they have.

2.7.1 Tangible User Interfaces (TUI)

The emergence of the term tangible user interfaces can be regarded a very significant stage in the search for new interaction styles combining physical world with computing. Ishii and Ullmer (2001) present tangible user interfaces as giving physical form to digital information by utilizing physical artefacts both as representations and controls of computational media. The following part will explain the main elements of TUI and their roles in realization of the interaction through the diagram in Figure 2.10.

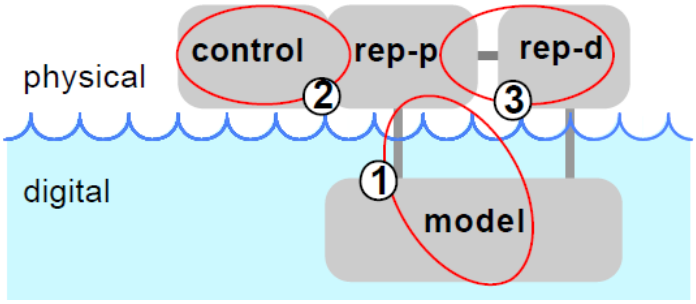


Figure 2.10 Physical and digital side of TUI

According to the framework which can be seen in Figure 2.10:

- Physical representations have a computational link with digital information.
- Through this link, these physical representations can be utilized as interactive physical controls. These controls can be realized by a variety of physical

manipulations such as rotation of a physical artefact or the attachment of one artefact to another.[1]

- Physical representations are paired with digital representations (graphics, audio and so on) which guide and/or inform users while interacting with the system. However, the configuration of physical representations itself can also reflect the digital state of the system to a certain extent (Ullmer & Ishii, 2001). Such unification of control and representation within physical artefacts eliminates the distinction between the input and output.

To clarify the key elements of TUI listed above, the next section will explore Reactable, which is one of the most popular commercialized products with tangible user interfaces.

Figure 2.11 Reactable (Reactable, 2014)

As can be seen in Figure 2.11, the cubical or prismatic tokens placed on the table are 'physical representations' of particular digital sound effects. These include sound

[1]These physical manipulations are grouped as spatial, relational and constructive approaches by Ullmer and Ishii, 2001. While in spatial approaches the system interprets the spatial configurations of physical objects, in relational approaches the relationship between the system and objects (the order, proximity etc.) is critical. On the other hand, the constructive approach offers a LEGO-like manipulation of objects (Ulmer and Ishii, 2001). However, these approaches can be multiplied with advances in technology which enable different type of physical manipulations to be interpreted by computational systems.

generators, effects, and sequencers (Reactable, 2014). Melodies are generated by physical manipulation of the Reactable objects such as "placing them on the Reactable surface, turning them and connecting them to each other" ('physical controls'). 'Digital representations' are well exemplified in the product description in Reactable website:

> The resulting sonic flows are represented graphically on the table surface, always showing the real waveforms that travel from one object to the other, turning music into something visible and tangible. (Reactable, 2014).

The composition of Reactable objects (physical controls and representations) as an input can also be regarded as a part of the output, since it directly reflects the musical composition together with the digital graphic representations (elimination of input-output distinction).

2.7.1.1 Technology behind Tangible User Interfaces

Tangible user interfaces require application of technologies which are able to track the position of physical objects and gestures as well as to create and sense physical alterations (Shaer & Hornecker, 2010). RF-ID (Radio Free Identification) tags have been largely used in TUI to detect and identify objects. In RF-ID tags, while the internal circuits store and process information, an antenna receives and transmits signals. TUI systems with RFID tags mainly consist of a tag reader and objects with tags. Another technology implemented in TUIs is computer vision which is mainly used for interactive surfaces which are able to track the positions of objects and to identify their color, size, form. Microcontrollers can be regarded as the main electronic elements used for physical computing. Sensors provide input to microcontrollers (Igoe, 2007) by capturing a large spectrum of physical properties including "light intensity, reflection, noise level, motion, acceleration, location, proximity, position, touch, altitude, direction, temperature, gas concentration, and radiation" (Shaer & Hornecker, 2010, p.77). The physical energy is converted into electrical energy used for actuators (Igoe, 2007) such as LEDs, speakers, motors and electromagnets to give visual, audio or haptic feedback to users (Shaer & Hornecker, 2010, p.77).

2.7.1.2 Strengths and Limitations as offered by TUIs

It is crucial to understand the advantageous and disadvantageous aspects of TUIs to discuss the application of similar approaches to the case of mobile listening in public environment.

2.7.1.2.1 Strengths

Shaer and Hornecker claim that particular tangible user interfaces, as in the example of Reactable, enhance collaboration since they can be explored and controlled by more than one person simultaneously (2010). However it is not the most relevant advantage of TUIs in terms of mobile listening activity which is an individual experience.

Beyond providing shared experiences, tangible user interfaces also take benefit of users' familiarity with their surroundings by involving elements which are literal parts of physical environment (Dourish, 2001; Shaer & Hornecker, 2010). This familiarity covers not only cognitive but also tangible aspects of interaction, which is evaluated under the title "tangible thinking" by Shaer and Hornecker (2010). Similarly, in his book *Phenomenology of Perception* Merleau-Ponty (1962) defines the act of touching as body's way of seeing.

Another advantage of tangible user interfaces is presented as 'space multiplexing' by Shaer and Hornecker (2010). It is defined as the variety and multiplicity of tangible interactive objects each of which is utilized for different functions. This variety in affordance is obtained thanks to the endless options for physical alterations that can be made in form, size, weight, color or position of the objects (Shaer & Hornecker, 2010). Being able to assign a specific function to each typical object contributes to 'persistent mapping' (Shaer & Hornecker, 2010). It means that the function of a unique tangible interactive object remains the same unlike graphical user interfaces where each mouse click or tap on screen can have different outputs (Shaer & Hornecker, 2010). This way it helps users getting used to a TUI system by eliminating the need of learning the function of an object each time. On the other hand, the multiplicity of the objects is also advantageous since it enables 'parallel

actions' by using several objects with diverse functions at the same time (Shaer & Hornecker, 2010).

The analysis above refers to how specific affordances can be created through variations in physical properties of objects. The psychologist Gibson (1979), first used term affordance to explain ecological perception. According to Gibson (1979) affordance means the action possibilities which are present in environment and available even if individuals do not perceive these possibilities and take action according to their capabilities. Norman interprets the term affordance to explain product properties as

> ...the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. [...] Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed. (1988, p.9)

However affordances should not be reduced to physical properties. The same argument has been used to criticize Norman's interpretation of affordances which is solely based on "perceptual motor skills of the user and the characteristics of the environment" (Hummels, 2000). Hummels (2000) states that user's intentions, feelings and appeal of the product can also afford users to interact with a product or not. To illustrate, the form of play button on a music player may afford users to press, however they never do that until they really feel like listening to music or aesthetics of product interactions motivate them to do so. Therefore, Overbeeke and Wensween (2003) assert that affordances should be reconsidered as 'irresistibles' by exploiting the sensory richness of users and appealing to user's emotional and cognitive skills. Regarding the tactile and kineasthetic aspects of interaction, tangible user interfaces have a significant potential for offering "irresistibles".

2.7.1.2.2 Limitations

The form of a TUI object defines a specific affordance and it cannot be altered due to the rigid and stable nature of the physical objects (Shaer & Hornecker, 2010). As

mentioned above, such rigidity may be advantageous since it erases the need of learning the function of an interactive object in each encounter. However, this concreteness can be problematic as well because it does not let the system modify the formal qualities of objects according to the dynamics of interaction (Shaer & Hornecker, 2010). This also limits the number of tasks that can be realized with tangible user interfaces.

Limits in modification of physical objects also involve "scalability" (Shaer & Hornecker, 2010). Each physical entity in TUIs takes up a space and area of interaction is defined by the complexity of the system. Unlike digital representations, physical TUI objects cannot be scaled or put in folder; they require the same space even if they are not in use (Shaer & Hornecker, 2010). Therefore, if the number of digital elements -to be represented and controlled by physical objects- increases; TUI system demands larger space.

Considering listening on-the-go and TUIs together, the requirements of space challenge the portable use which is the main motivation behind mobile listening. When TUI applications are overviewed, one can hardly come across a portable system enabling outdoor use. Even though the contextual factors are excluded; simply miniaturizing the large systems may not work; because the size of an object will affect the way it is physically manipulated like in the example of power and precision grip. Hence when it comes to the issue of portability designers have to decide how heavily the controls should depend on TUIs.

Nevertheless the size of the system is not the only matter for portability, the way it is made portable (e.g. wearability) should also be considered. With this in mind, instead of trying to design small portable objects to increase mobility, one can even take the advantage of the required area for the system as long as the product/interface is comfortably portable. To illustrate, expanding the interface onto larger surfaces provide greater room for accessibility of controls while on-the-go.

Lastly, Shaer and Hornecker (2010) include 'user fatigue' in the list of limitations of tangible user interfaces because of the longer-term strain of the manual activity

needed to perform actions. However, the manual workload can also be justified when it is presented as a challenge to be enjoyed by users in "action mode" (Hassenzahl, 2007), in other words, it can be gamified.

There are a variety of applications of physical computing that eliminates the particular limitations of TUIs. They expand the notion of physicality by providing more flexible solutions. This flexibility stems from not only the flexible use of computing but also flexible way of thinking. Therefore, the following sections will explore how data- centred view of TUI is reframed with action-centred view, how problems regarding the rigidity of TUI objects can be overcome by organic user interfaces, and how our interactions with digital interactive systems is enhanced via inclusion of bodily movements and gestures as well as physical objects as in TUI.

2.7.2 Organic User Interfaces

Organic user interface is defined as "a computer interface that uses a non-planar display as a primary means of output, as well as input (Holman & Vertegaal, 2008). Holman and Vertegaal (2008) put special emphasis on 'display' because they believe that, thanks to the flexible display technologies, the non-planar objects which have been used as control and physical representation of digital data in tangible interfaces can be used to display digital representations as well. It points out a further unification of input and output. Holman and Vertegaal (2008) assert that the flexibility of organic user interfaces makes them compatible with different contexts.

As mentioned in the definition, it is for sure that displays are not just means of visual representation but also controls as in the example of multi-touch screens. Therefore, regarding OUI, what is most interesting for the scope of this thesis is the flexibility of physical controls rather than wrapping-up of objects with GUI displays.

2.7.2.1 Technologies

There are particular technologies that have contributed to the expansion of the ways users physically manipulate computational items. Holman and Vertegaal (2008) illustrate such 'flexible input technologies' with different types of interactive surfaces. Some include SmartSkin with 'capacitive sensing' which enables any non-

flat surfaces to track the hand gestures without need of a camera (Rekimoto, 2002), and ShapeTape with optical fibres which sense bending (Grossman, 2004). In another article 'foldable input devices' are also presented as flexible input technologies. They consist of paper-like materials and "IR retro-reflectors, the shape and position of which is tracked through an IR web cam" (p.283); this way the physical alterations such as "thumb slide, scoop, bend, fold, leafing and squeeze" can be used as controls (Gallant et. al, 2008).

Follmer et al. (2012) from MIT Media Lab present 'jamming user interfaces' as malleable organic user interfaces (Figure 2.12 and Figure 2.13) in which the stiffness of material can be computationally controlled. These interfaces use two main shape sensing technologies; index-matched particles and fluids, and capacitive and electric field sensing, to sense physical manipulations such as stretching, bending, moulding as inputs. As can be seen in Figure 2.13 some of these interfaces are also applicable to mobile devices; which also make them applicable to mobile listening activity.

Figure 2.12 Tunable Clay: Malleable interface used for 3d modelling which use optical sensing technology (MIT Media Lab, 2012).

Figure 2.13 The ShapePhone: A mobile device which can be transformed into different jammed shapes (MIT Media Lab, 2012).

Shape changing materials are also mentioned under the technologies enabling digital controls through physical transformations. Compared to the others, shape changing materials also have the ability to adjust their 3D shapes as a reaction to inputs of users. Shape memory alloys which can imitate the bodily movements according to environmental stimuli can be given as an example to this kind of materials (Holman and Vertegaal, 2008).

While describing 'shape changing interfaces' as a corresponding interaction model to OUI, Rasmussen et al. (2012) come up with a table which recovers the possible physical manipulations of the objects' forms through clear schematic representations and product examples as shown in Figure 2.14.

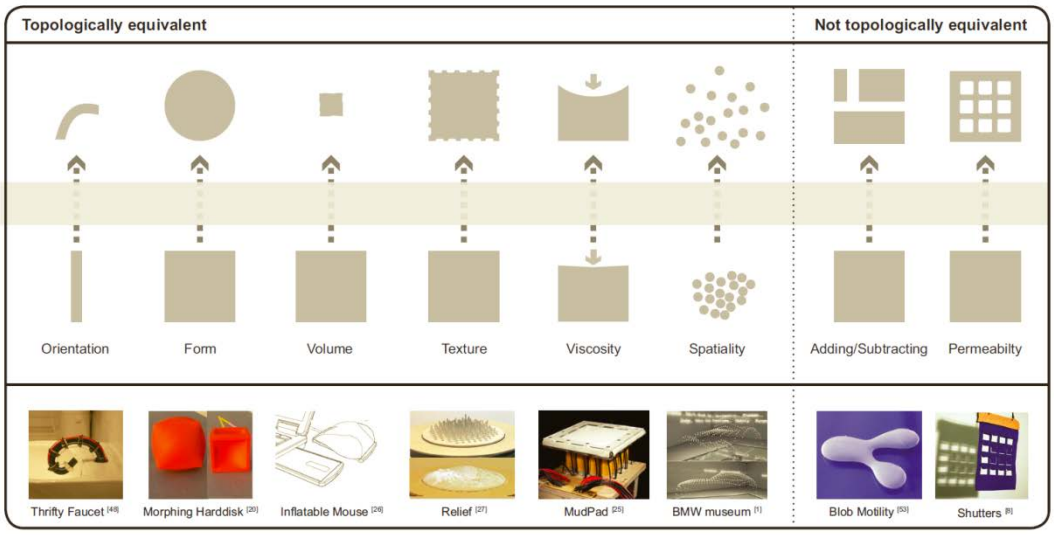


Figure 2.14 Types of shape change: Flexible ways of physical manipulations of objects (Rasmussen et al., 2012)

2.7.3 Beyond Tangible User Interfaces

TUI is selected as a starting point for exemplifying different forms and levels of embodied interaction. Before continuing with other types of interfaces, in the following part the underlying conceptual arguments behind the new interface models will be discussed.

Ferneaus et al. (2008) set new ideals for tangible interaction by providing a critical analysis of earlier TUI frameworks which are constructed on the idea of

representation and control of data. These new ideals promote a shift from "data-centric view to an action-centric view", from "properties of system to interaction in context", from "individual to sharable" and finally from "objective to subjective interpretation" (Ferneaus et al., 2008, p.225).

What is meant with action-centric view is approaching physical objects not only as representation of data but also as "resources of action" (Ferneaus et al., 2008) as Dourish (2001) mentions in his book *Where the Action Is: The Foundations of Embodied Interaction*. Instead of focusing on how digital data is represented and transformed with tangible objects, this action-centric view puts emphasis on the presence and role of these objects in our physical and social activities; because only by referring to these activities designers can balance the use of digital and physical resources. This ideal also supports the utilization of physical elements that mobile listeners carry everywhere with music as resources of inter-action. Hornecker and Buur (2006) also list alternative approaches to data-centred view with "expressive-movement centred view" and "space-centred view". While the first one underlines the bodily interaction with objects, the latter one refers to the expansion of users' physical interaction to the interactive spaces.

Ferneaus et al. (2008) also argue that considering solely the functional elements of the system is not adequate; rather what a user or users together will do in settings of the system should be taken into account. Especially in mobile listening, designers of tangible interaction have to consider the qualities of public environment, mobility of users and presence of other people. Therefore the problem is not just to solve how audio controls can be performed physically but also how they are performed in public context of use.

Aside from individual use, the potentials of tangible user interfaces to provide shared experiences (as in the example of Reactable) are also underlined as a new ideal in "practice turn" in tangible interaction (Ferneaus et al., 2008). Although mobile listening is regarded as 'individualization' of space, people can still configure a shared experience in mobile listening through simultaneous listening or shared music. To illustrate, "Undersound" is a music-sharing application concept which

enables users to upload their tracks to London Underground ticket halls to be downloaded by other users with the application. This exchange of music is stored in the application to visualize the movement of music within "Undersound" network (Bassoli et al., 2007). Despite such possibilities provided by ubiquitous computing for social interaction through mobile listening; this ideal is beyond the scope of this thesis, which is more concerned with challenges in 'moments' of mobile listening as a personal experience 'performed' in public environment.

Lastly, Ferneaus et al. (2008) claim that tangible interfaces should let users make subjective interpretations because the way users make sense of interaction is inevitably individual and possibly "non-intended". These subjective and non-intended interpretations derive from the dynamics of activities. This ideal finds its place especially in organization of fieldwork in this thesis where participants are expected to perform particular activities while listening to music to uncover such subjective interpretations.

2.6.4 Body as an Input Device: Gestural and Full Body Interactions

So far, under the title of different forms of embodied interaction, the role of physical objects in digital interactive systems is explored. This section will be focusing on how particular interface types utilize parts of or whole body as an input device (Fogtmann et al., 2008).

Embodiment and inevitable participation of body in our daily activities results in different terminology for interaction styles where the body is the intersection point. For example, Overbeeke et al. (2007) use "movement-based interaction" as an umbrella term referring to both gestural and full body interaction as well as other user interactions which are not necessarily with computational devices but involve particular bodily rituals in use.

Interfaces which are based on bodily movements have strong connections with "kinesthesis" which can be defined as a part of our sensory motor skills which deals with "the perception of the position and movements of one’s body parts in space"(Fogtmann et al., 2008, p.91). Therefore it can be argued that digital systems

with bodily interactions inevitably offer a certain type of aesthetics of interaction; which is called as 'kineasthetic interaction'. To discuss potentials of the contextual elements in designing aesthetic interactions, all sensory modalities should be included in research, including kinesthesis.

To exemplify the utilization of body to control digital systems, this part will be exploring both full/whole body interactions and gesture-based interactions. It would be wrong to present these as two separate forms of interaction because whole body movements can be also regarded as bodily 'gestures'. Here it is essential to provide a definition of gesture. Saffer (2008) defines gesture as

> ...any physical movement that a digital system can sense and respond to without the aid of a traditional pointing device such as a mouse or stylus. A wave, a head nod, a touch, a toe tap, and even a raised eyebrow can be a gesture. (p.4)

The whole body interaction eliminates the need of manipulating objects within reach of arms or hands of users and enables users to act in a larger space which can track user's bodily movement (Shaer and Hornecker, 2010). Hence, the reason behind the differentiation of the term whole-body interaction from gestural interaction is its reference to space.

To continue with gestural interfaces; they are classified as touchscreen gestural interfaces and free form gestural interfaces by Saffer (2008). While in the former the controls are limited to the movements of hand on the screen -in other words- touch gestures, in the latter one, users can control the system only with their bodies; without an object to touch or handle except for some wearables or controllers (Saffer, 2008). In that sense, it can be claimed that free form gestural interfaces cover what is called full body interactions.

2.7.4.1 Technologies

Discussing the potentials of gestural interfaces to enhance mobile listening experience in public environment requires an overview of related technologies and their possible applications.

Technologies required for using body as input are quite common with the technologies used in tangible user interfaces. They also involve sensors for input; microcontrollers for processing the input; and actuators for output. Regarding the use of sensors, it is important to detect a number of parameters related with body and bodily movements including, "speed", "motion" and "orientation" (Saffer, 2008). The types of sensors which are mainly used in gestural interfaces can be listed as pressure, light, proximity, acoustic, tilt, motion (accelerometers, gyroscopes) and orientation (Saffer, 2008, pp.13-14).

Fogtman et al. (2008) clearly explain that any element of interaction can embody sensors while they discuss the interactive technologies required for kinesthetic interaction. As can be viewed in Figure 2.15 sensors can be placed on user's body, in the equipments and/or in the environment.

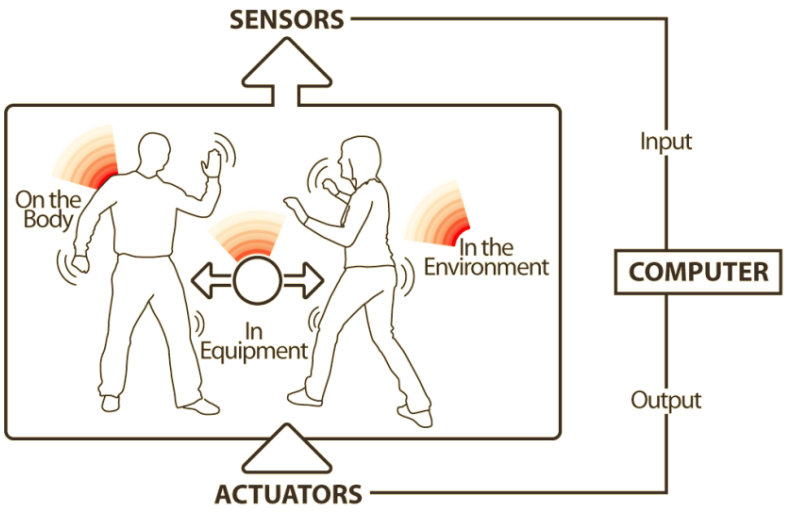


Figure 2.15 Possible elements of bodily interactions for sensor attachment (Fogtmann, et al., 2008)

For instance, in Wii (Figure 2.16), the controllers have built-in accelerometers and gyroscopes to detect tilt and motion (in equipment). The system also includes an infrared sensor to detect orientation of users (in the environment) (Saffer, 2008).

Figure 2.16 Reflection of user's motion on digital screen in Wii (Nintendo-World, 2013)

As far as mobile listening activity is considered, it is least likely to place sensors in environment since mobility means constant change of environment. Thus it would not be preferable to design controls which are based on position/orientation of user's body according to a reference point. However, body and portable equipments as embodied parts of mobile listening activity are available for attachment of sensors. To illustrate such application, iPod Nano, (in collaboration with Nike) has a built-in pedometer and gives instant audio feedback to users about their workout and let users adjust their music that matches with their pace (Apple, 2014). It is for sure that, here running activity cannot be regarded as a bodily gestural control since it is not performed for the sake of controlling the device. Yet, it is a nice example of considering and taking advantage of other accompanying bodily activities while designing the controls of the device.

2.7.4.2 Strengths and Limitations as Offered by Gestural Interfaces

Like many other types of interfaces; gestural interfaces have their strengths and limitations.

2.7.4.2.1 Strengths

Saffer (2008) also mentions about advantageous aspects of gestural interfaces by asserting that they provide "more natural interactions; less cumbersome and visible hardware; more flexibility; more nuance and more fun" (p. 17-19).

Saffer (2008) claims that gestural interfaces offer more natural interactions; because they enable users to interact with digital devices like in the way they interact with physical objects. Norman (2010) raises an objection to this argument in his article "Natural user interfaces are not natural". Norman justifies this title by saying that gestures neither provide any affordances in advance, nor they leave any trace behind, which makes it difficult to relate the response of the system with the gesture that has been done. He adds that this problem can only be overcome by inclusion of other conventional interface elements such as menus and guides.

It is less controversial that gestural interfaces eliminate the need of hardware to perform interactions by utilizing body as an input. Especially free form gestural interfaces erase the need of storing, carrying or finding particular hardware; which can be beneficial for mobile listening activity in which users have to find a place to put their devices and access them when they want to control music. Thanks to small sensors which can detect sufficient input; controls no longer need to be confined into small space especially in mobile devices.

As another positive aspect of gestural interfaces, it is claimed that they have more nuance; in other words, gestures have more distinctive characters compared to other traditional types of control such as mouse clicks. Such nuance derives not only from the use of bodily movements as a sensory modality, but also the possible meanings and emotions associated with these gestures (Saffer, 2008).

Finally, gestural interfaces are presented as sources of fun since they encourage users to directly involve the interactive system more (Saffer, 2008).

2.7.4.2.2 Limitations

Saffer (2008) mentions that gestural interfaces (both touch screen and free form) can be problematic in case of heavy data input and because of their reliance on visual feedback and on the physical movements, and their inappropriateness for certain contexts. To explain the case of heavy data input he compares touch screen and keyboards and argues that keyboards provide a faster use while entering text. Norman (2010) describes using only gestural interface in complex systems with an

analogy of speaking a language with only verbs. Nevertheless, such limitations will not be a concern for mobile listening activity in which users do not have to enter such heavy data to the device.

Another critique raised for gestural interfaces is that the feedbacks are mostly based on visuals. They fall short of giving such confidence as in the physical feeling of pressing a button since touching means being touched. Saffer (2008) mentions about its limitations for visually impaired people; however, this concern also applies to the activities where the visual feedback is inapplicable (Hoggan & Brewster, 2007) such as mobile listening where users carry their devices in their bags or pockets and move in an environment with lots of visual stimuli. This limitation constitutes one of the main motivations behind the emergence of 'multi-modal interfaces' in which controls and feedbacks involve more than one sensory modality.

Reliance on the physical can also be disadvantageous depending on the type of physical movement, which may require special skills or may not be performed due to the environmental constraints (Saffer, 2008). These constraints can be social as well. For instance, users can feel reluctant to perform[2] some gestures not to draw attention of others, and to keep their activity more private. This reluctance can be explained through what these gestures 'culturally signify'. It can be claimed that the invisibility of controls increase as the gestures become more of our "know-how" and gain "cultural signification" (Du Gay et al, 1997). Therefore, it is impossible or unforeseeable to make a classification of appropriate and inappropriate gestures to control music players in public environment. Hence this research solely reflects on the related concerns of the users which can guide designers while designing the interactions of future mobile listening devices.

2.7.5 Multimodal Interaction

Our body participates in our daily activities with all our senses. However, the controls and outputs of each type of interface which is mentioned above actually

[2] Whole body interactions or free-form gestural interfaces are presented as "performative interactions" which turn users into the performers of gestures and other people into the spectators of this performance. (Williamson, 2012; Shaer & Hornecker, 2010; Reeves et al., 2005).

gives priority to specific sensory modalities and other modalities are involved in interaction as an inevitable consequence of user's presence. This chapter highlighted the significance of exploiting the sensory richness of users by underlining the centrality of tactile and kineasthetic interactions in tangible, organic and gestural interfaces. Now, this section will lastly touch upon the interface types where different modalities are specifically utilized in controls and outputs of the system within multimodal interactions.

Multimodal interfaces are defined by Oviatt (2002) as interfaces which

> process two or more combined user input modes— such as speech, pen, touch, manual gestures, gaze, and head and body movements— in a coordinated manner with multimedia system output. " (p.418)

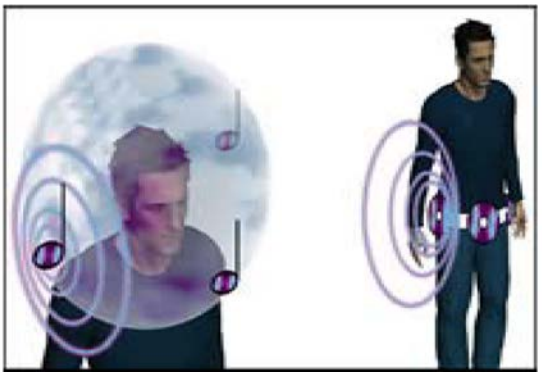


Figure 2.17 The message conveyed through the audio as well as the tactile alerts (Hoggan & Brewster, 2007).

Hoggan and Brewster's (2007) "Crossmodal Icons"[3] can be given as an example of multi-modal feedback for mobile devices (Figure 2.17). While "earcons" give audio feedback to users, "tactons" give tactile feedback to users. They are designed as an alternative to visual feedback which cannot be utilized in particular situations such as being in a meeting or listening to music (Hoggan & Brewster, 2007). Hoggan and Brewster (2007) claim that the use of both tactile and audio feedbacks gives users the chance to alternately make use of earcons (when users do not have a direct physical access to tactons as in the case of carrying the device in bag); or tactons (when users

[3] Semantically if there is an iconic or symbolic relationship between the alerts and tactile/audio feedbacks is debatable. Same critical note also applies to "Phicons" of Ishii and Ullmer (1997) which supposed to refer physical representation of data in tangible user interfaces; and it is implied that such representation is symbolic rather iconic (Shaer & Hornecker, 2010).

are in noisy environment or do not want to disturb others with sound alerts). It is also claimed that tactile and audio feedbacks together constitute an ideal crossmodal combination regarding their temporal and spatial properties. Both senses can be utilized to give "intensity, rate, rhythmic structure and spatial location" of an alert (Hoggan & Brewster, 2007).

As the example shows, one of the biggest contributions of multimodal interfaces appears to be the flexible use of input. It means that users are able to choose which type of modality they will use to convey particular type of information (Oviatt, 2002). The appropriateness and applicability of using a particular input modality depends on the context of use as mentioned under gestural user interfaces. In that sense, the freedom of selection of how to control or get feedback from the system becomes an important characteristic of multimodal interfaces (Oviatt, 2002). Oviatt also mentions that the adaptability of multimodal interfaces to different contexts also enhances mobile tasks in which contextual factors keep changing; and this is highly relevant for activity of mobile listening as well.

Multimodality also helps users in error prevention and handling (Reeves, 2004; Oviatt, 2002). Errors can be minimized by complementary features of two or more integrated modalities or selection of the most convenient modality to context. In case of an error, users can handle the situation by switching to another modality (Reeves, 2004).

The underlying reasons behind the advantages of multimodal interaction are explained with the theories of cognitive psychology. Dumas et al. (2009) states that our cognitive skills enable us to process different modalities partially independently, which means multi-modal controls and feedbacks can be interpreted by user in an efficient way.

Above-mentioned strengths of multimodal interfaces mainly highlight the efficiency of interaction and use of cognitive skills. However it should also be emphasized that they also promise creation of diverse forms of aesthetics of interaction through combination of multiple modalities.

So far practical reflections of the notion of embodied interaction are explained through a variety of interface models. It is important to note that these different forms of interaction are not strictly given in chronological order. Since they are all inspired from our embodied actions in the world, it is meaningless to say which type of interface has first utilized tangibility in digital interactive systems. The order in this literature review mainly followed the transition from graphical user interfaces to tangible user interfaces and then to tangible interaction with a strong emphasis on practices and the context. Multimodal interaction can be regarded as a parallel improvement which makes use of different means of control and feedbacks together.

2.8 Summary

This chapter has touched upon particular conceptual frameworks to be referred in the analysis of mobile listening in public environment. This conceptual overview firstly has reflected on mobile listening as a part of culture. To do so, it has dealt with how mobile listening activity is associated with particular identities, practices and objects and how these meanings and practices are produced and reproduced through new technologies. What is meant by 'practices' can both refer to the way we interact with products (including 'aesthetics of interaction') and particular activities such as travelling with music. To draw the scope of these interactions and activities, the focus of this research is entitled as mobile listening in 'public environment', instead of mere mobile listening. Referring this context of use, the earlier insights are followed by exploration of mobile listeners' relationship with public environment. The exploration includes how mobile listening individualizes the space through creation of an auditory bubble and how it connects and separates public and private spaces through 'sonic bridges, doors and interchanges'. How this auditory bubble emerges and disappears within the dynamics of public environment including social interactions and all types of stimuli (not necessarily sonic ones) has also been mentioned.

Together with the cultural aspects of mobile listening, it is also necessary to evaluate mobile listening as a 'user' experience, since it actually derives from the interactions between the user and any media of mobile listening. Therefore, in the literature review, how user experience is conceptualized has also been explored with a special

focus on user experience frameworks which put special emphasis on the context of use. There are two main reasons why context is underlined: first, to understand user-product, product-product and user-user relations; and second, to discuss how embodied actions and elements within the context can be utilized in interface design.

The potentials of contextual factors for user-product interactions are explained through embodied interaction. Here embodied interaction is used to conceptualize aesthetics of interaction[4], because our notion of aesthetics is also shaped with our physical and social interactions in the world. However, this conceptualization is not limited to a theoretical account. The practical reflections of 'embodiment' on different forms of interaction are also mentioned within this literature review. It starts with tangible user interfaces as one the first examples utilizing physical objects as representations and controls of digital data. However, this data-centred view is alternated with practice-centred view, which presents physical objects as resources of action. Nevertheless, embodied interaction is not only limited to the use of physical objects but also physical movements, which constitute the main source of controls in gestural and full body interactions.

All interaction models have different forms and levels of embodiment. Since they are sourced by different sensory modalities, they provide different opportunities for aesthetics of interaction. It is certain that mobile listening is already aestheticised by the music itself. What is questioned with this research is whether this aesthetic experience can be enhanced with the elements and actions which are embodied within the context of use. Such an approach requires considering context with its inspirational as well as challenging aspects. Hence the following parts of the thesis will reflect on what interacts with or accompanies users together with music and how.

This part of the literature review has provided the underlying conceptual frameworks to analyse mobile listening experience in public environment. The literature review presented in Chapter 3 continues with the analysis of more practical aspects of

[4] Wright et al. (2007) mention that Peterson et al. (2004) also use embodiment to conceptualize pragmatic aesthetics.

mobile listening by focusing on mobile listening devices as essential parts of mobile listening user experience. Therefore, the next chapter will explore how this experience has evolved through the advancements in technology and the introduction of new products.

CHAPTER 3

EVOLUTION OF MOBILE LISTENING EXPERIENCE

3.1 Introduction

Music is an embodied part of our lives. However, we rarely question how it has been made possible to access and enjoy music that easily. This chapter will be focusing on how changes in technology have affected the way people interact with and experience music and music players besides giving a historical background of mobile listening.

The first part of the literature review, as presented in Chapter 2, has underlined that what makes mobile listening a 'user experience' is the mobile listening media used by people. Therefore, to exemplify the evolution of our listening experience, this part will be referring to consumer products -in this case music players- within a timeline that consists of particular milestones in sound technologies. This evolution comprises the transformation of 'listening' to 'mobile listening' with the transformation of 'music players' to 'personal music players'. This will be followed by the transformation of mobile listening especially with different sound recording and reproduction technologies, and other related technological advancements. To do so, the Chapter will look at how each technology offered new practices (interactions or activities) and meanings.

3.2 Phonautograpgh: The Very First Attempt to Record Music

When 'evolution' is mentioned, one should keep in mind that the contemporary way of listening to music is traceable to the very first phonautograph (Figure 3.1), which was invented by Leon Scott in 1857 to record sound signals graphically via a vibrating diaphragm and stylus (Donald C. Davidson Library, n.d.).

Figure 3.1 Phonautograpgh (Library and Archives Canada, 2007)

3.3 Reproduction of the Sound

Thomas Edison's phonograph (Figure 3.2) constitutes the second stage in this brief overview of history of music players. The phonograph combined recording with the audio playback function, in other words reproduction of the sound. This was made possible by recording the sound in wave forms to phonograph cylinders later to be reproduced by tracing these wave forms by a stylus (Donald C. Davidson Library n.d.).

Figure 3.2 Phonograph (The Library of Congress, 2014)

The form of recording tools evolved from cylinders to Berliner's flat discs played on gramophones. These flat discs were the first sound recording tools that can be mass

produced, which inevitably contributed to emergence of "industry" of music (The Library of Congress, 2014; eBay, 2014). The gramophones are followed by electric record players.

3.4 The Introduction of Portable Music: Portable Transistor Radios

Continuous access to music and portability are very significant aspects of mobile listening. Above, how people started to access to recorded music indoors has been explained. However, when it comes to portability of music, it can be seen that the first attempts for carrying music to 'everywhere' were actualized with the introduction of portable transistor radios that ran on batteries.

Figure 3.3 shows the first portable transistor radio, Regency TR-1, which was introduced to the US market in 1954 (Regency TR-1 Transistor Radio History, 2014). The controls of this portable transistor radio consist of one main analogue tuner and the tiny on/off- volume control dial. As can be viewed the device was available in variety of colors.

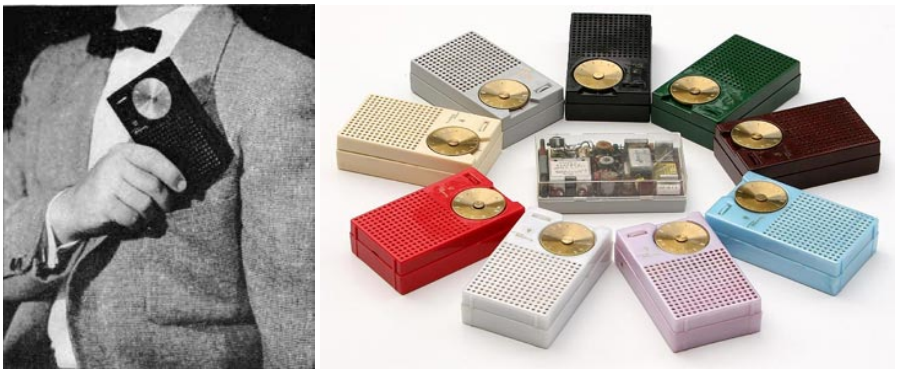


Figure 3.3 The 'pocket'-size first portable transistor radio-Regency TR-1 (Radio Museum, 2014)

After the introduction of the first portable transistor radio by the firm Regency/Texas Instruments, many other firms like Raytheon, Tokyo Tsushin Kogyo (today's Sony) also released their own models with different stereo capabilities (Regency TR-1 Transistor Radio History, 2014) that directly influenced the size of the product. They also varied in portability options such as with addition of a handle especially when they are no longer in pocket size to be carried with jackets.

Figure 3.4 A portable transistor radio released by Sony with higher stereo capabilities compared to Regency TR-1 (RetroThing, 2013)

When users' interaction with the radios is compared to the earlier forms of listening to music with gramophones and electric record players, one can see a significant difference in their aesthetics of interaction. The interface offered by record players is richer in tangibility through users' direct physical engagement with reproduction of the sound by placing the needle onto the record and observing the output of this control as in the most obvious way as possible. The physical representation of music through the records also enhances this aesthetic interaction by enabling the users physically interact with (e.g. to classify, to store) another media than the music player itself. However, in radios these rituals transform into more generic controls such as turning the knob or pushing the button which are not really particular to listening activity. Although button-based controls have dominated the interface of music players for a long time; the new recording technologies and the music players designed to play the media produced by these technologies have kept introducing new rituals (interactions) to the users. One of these sound storage media is the cassette.

3.5 Cassette Technology & Tape 'Recorders'

Portable transistor radios enabled users to listen to their favourite *station* while on-the-go. However, what first enabled them to listen to their favourite *album* on-the-go were portable cassette players.

The history of the cassette draws back to the emergence of magnetic recording technology with "telegraphone" (1898), the introduction of magnetic tapes and the

invention of "magnetophone" by the German brand AEG in the 1935 (Holmes, 2006). It was an earlier version of reel to reel tape recorders.

These developments were followed by the release of tape cartridges (cassette) by RCA which embodied the reel to reel system inside and enabled users who lacked technical background as well to record and playback their voices just by inserting the cartridge into the player and starting the rotation automatically with a button (Sony, 2014). For a while, there was no standardization for these cartridges until Philips introduced 'compact cassette' which was far smaller in size compared to its previous versions (Sony, 2014). This enabled users to enjoy the portability of tape recorders more.

The name tape 'recorder' shows us the fact that the main idea behind the invention was sound recording and dictation. It was initially targeting people with particular professions such as secretaries and journalists. Utilization of compact cassettes as medium of music industry was realized later with the introduction of pre-recorded tapes in the late 1960s (Haire, 2009). In this regard, one of the various types of cartridges -8-track tape (Figure 3.5) is worth mentioning. 8-track tapes were designed just a year after the introduction of Philips's compact cassette prototype for the Ford's new car models of 1965 to play music on the car (Audio Engineering Society, 2014), which can be regarded as another way of listening to music on-the-go.

Figure 3.5 Bucks Burnett: the collector and founder of Eight Track Museum in Dallas, Texas, holding a Lou Reed 8- track tape (Dallas Observer, 2010)

As years passed portability of the music players increased. We see that even a decade later from the invention of 8-track tapes and compact cassettes, companies kept producing both 8-track and cassette players and let their customers decide which one to choose. Among these products, one of the most iconic 8-track player designs belongs to Panasonic's "Dynamite 8-track player" (Figure 3.6).

Figure 3.6 Panasonic "Dynamite 8-track player" (Imcargade, 2014)

It provides a unique aesthetics of interaction by offering a plunger to be pushed to switch between four channels in the 8 track-tape. The way we interact with the plunger as if we are dealing with a more alarming situation contributes to the name of the product -Dynamite- which refers to its stereo capabilities. The plunger is also utilized as a handle for carrying the product.

3.5.1 Boomboxes: Carrying the 'Beat' Everywhere

The portability of this kind of products is questionable considering what we understand from portability today. To make something light and compact enough to carry to somewhere else does not ensure that it offers enough convenience to take it with us everywhere. In this case, the main obstacle seems to be their size which is determined by the fidelity of the sound. However, when we look at the use of boomboxes which appeared on streets in the late 70s, it is clear that the need of self-expression can 'beat' our concerns for the portability of the product. Even more, its enormous size and the way it is carried on shoulders (Figure 3.7) highlight the impression that users want to evoke. It somehow constitutes the main formal characteristic of that particular sub-culture. The identification of the boombox with certain segments of the society shows itself in the nicknames it has gained so far like

'ghetto blaster' and 'jam box' (Owerko, 2014). These meaningful associations of boombox with particular activities, identities and places constitute a very nice example for the term cultural signification as well as experience of meaning.

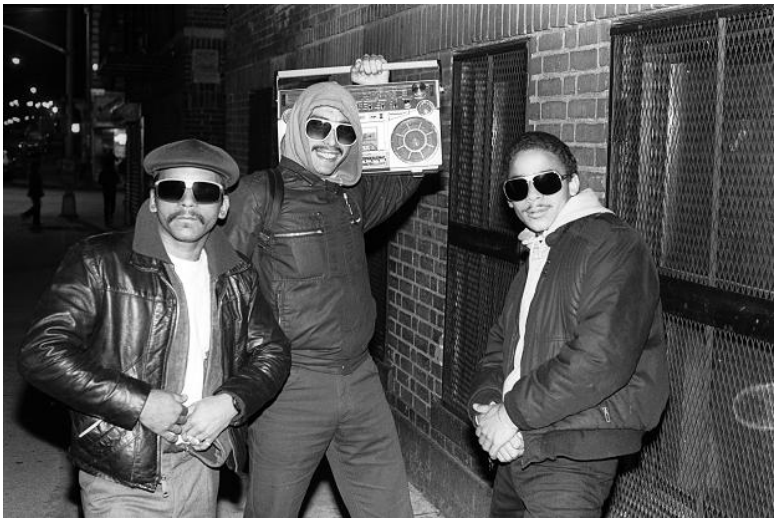


Figure 3.7 Boombox on shoulders (The Times, 2014)

A song from the 80s called "I Can't Live Without My Radio" by the rap singer L.L. Cool J has quite slang yet insightful lyrics regarding the domain of interaction and all dimensions of Boombox experience, especially, the meaning of the product which is enhanced by the high fidelity of the sound and portability of the music within a particular urban environment-his tough neighbourhood.

> My radio, believe me, I like it loud- I'm the man with a box that can rock the crowd- Walkin' down the street, to the hardcore beat-While my JVC vibrates the concrete- I'm sorry if you can't understand-But I need a radio inside my hand- Don't mean to offend other citizens- But I kick my volume way past 10-My story is rough, my neighbourhood is tough- But I still sport gold, and I'm out to crush-My name is Cool J, I devastate the show- But I couldn't survive without my radio- Terrorizing my neighbours with the heavy bass- I keep the suckas in fear by the look on my face- My radio's bad from the Boulevard- I'm a hip-hop gangster and my name is Todd-Just stimulated by the beat, bust out the rhyme- Get fresh batteries if it won't rewind- Cos I play every day, even on the subway- I would got a summons but I ran away- I'm the leader of the show, keepin' you on the go-But I know I can't live without my radio. (L.L. Cool J, 1985)

3.6 The Milestone: Walkman

Sony was one of the leading companies to introduce series of portable cassette recorders to the market thanks to its expertise in miniaturized electronics (Haire, 2009). In 1979, Sony launched the first version of its revolutionary product - Sony Walkman-TPS-L2 (Figure 3.7), which can be regarded as a true milestone in the history of mobile listening. It was a "14 ounce, blue-and-silver, portable cassette player with chunky buttons, headphones and a leather case. It even had a second earphone jack so that two people could listen in at once" (Haire, 2009).

Figure 3.8 Sony Walkman-TPS-L2: The first personal portable music player (Sony, 2014)

What made Sony Walkman an ideal product for those who wish to own a compact cassette player to be used on-the-go was its "unprecedented combination of portability and privacy" (Haire, 2009) that was made possible by the use of two AA size batteries as an energy source and embodiment of a headphone jack instead of external speakers.

It is clear that the product and its name was largely inspired from Sony Pressman, a portable cassette recorder utilized as the base of first Walkman prototype (Haire, 2009). However, the first generation of Walkman was launched as 'Sound-About' in the US, as Stowaway in the UK, as Walkman in Asia, the Middle East and Latin

America, and as Free Style in Sweden considering the possible unacceptability of the term Walkman as an ungrammatical name in English (Du Gay et al., 1997). Nevertheless, regarding the cost effects of coming up with a not copyrighted name for each country (Haire, 2009), the company decided on one common name for its product-Walkman. The name Walkman definitely achieved highlighting the mobility that product provides to the users. The very first logo had been designed to strengthen this message with 'A's in the form of walking legs.

Walkman achieved to answer people's wish for mobile listening so well that the 80s can be considered as a Walkman decade (Haire, 2009). Despite the company's earlier concerns for the ungrammatical name Walkman, it later became very popular and even turned into a generic term for personal portable cassette players (Du Gay et al., 1997).

What about the target users? Walkman was originally aimed to appeal to mobile young music listeners. However, soon after the company realized that wider range of people preferred to use Walkman, they developed new marketing and advertising strategies targeting not only "urban youth" but also "the lovers of outdoor pursuits" (Du Gay et al., 1997, p. 66). This strategy was also reflected upon the form and technologies of the new the Walkman series. Walkman was customized and varied with versions that are solar-powered, waterproof, and attachable to sweatband (for tennis-like sports) (Figure 3.9). Some designs also embodied AM/FM receivers and/or clock (Du Gay et al., 1997) and even one additional cassette driver (Time, 2009). Children were also one of these target consumer groups. "My First Sony" range available in primary colors was designed for kids to construct a brand loyalty from that ages (Du Gay et al., 1997). Although we mainly focus on the urban use of portable music players, these attempts to diversify the product with the help of available technologies are inspirational for enhancing the product experience considering the dynamics of the context of use and the type of mobility.

Figure 3.9 Solar powered (on the left) and the waterproof (on the right) Walkmans (Stereo2go, 2014).

3.7 The Digital Era

Meanwhile, a new medium of optical recording was introduced by Philips with Compact Discs (CD) in 1982. The complex technology behind CD can be explained with digital data processing (representation of the sound as a digital data), optics and mechanics. We can briefly describe the main principles of the reproduction of the sound in CDs as follows: A focused laser beam is sent to the surface of CD which contains digital information in the form of tiny pits whose pattern determines the way the laser is reflected to a photodiode. Then the digital sound signals are detected and converted into analogue audio information (Philips Research, 2014). To sum up it is the laser beam that actually reads the audio information through an optical process which detects digital signals to be transformed into the analogue ones.

Sony was not late to adapt this technology. Just after the introduction of CD, as a result of its partnership with Philips, Sony launched its first portable CD player Discman D50 (Figure 3.10) in 1983 (Sony, 2014).

Although Discman and Walkman both enabled people to access recorded music on-the-go, Discman brought the advantage of skipping tracks more easily without forwarding or rewinding. This made the access to a specific song much faster. Beside its positive contributions to our listening experience, it fell short to provide a

comfortable portability due to its larger size than Walkmans that requires a dramatic change in fashion to fit in pockets.

Figure 3.10 Discman D50: the first portable CD player (Sony, 2014).

3.8 The Introduction of MP3: Dematerialization of Sound Storage Media

The digital era continued with another important milestone in mobile listening technology: the introduction of MP3 in 1998. This file format reduced the amount of data needed to store audio track information (Fraunhofer IIS, n.d.). Initial utilization of this compressed file format in an inevitably 'compressed' size of a portable music player was realized with the introduction of 'Rio 100' by Diamond Multimedia (Figure 3.11) in the US and 'MPMAN' by Saehan Information System (Figure 3.12) in South Korea (Fraunhofer IIS, n.d.). These MP3 players were using a solid-state flash memory to store and play MP3 files downloaded from internet or transferred from a CD (Fraunhofer IIS, n.d.).

Figure 3.11 'Rio 100': the first MP3 player by Diamond Multimedia (House of Tracks, 2012)

Figure 3.12 MPMAN (Flickr, 2014)

Except from radios, until the introduction of MP3 players the media that we used for listening to music were used to involve three main items: a medium for music storage (flat discs, cassette, CD etc.), the player and the headphones. MP3 players with their own music storage took away all our physical interaction with the music media. Aside from our sensorial interaction with the MP3 player itself, the way we organize, select and carry these music storage media dramatically got dematerialized. Therefore, it both altered the user-product interactions and product-product interactions, in other words, the compositional character of the listening experience.

Another point worth mentioning about the introduction of MP3 players is the decrease in size of the product. This is always promoted as an advantage for the portability; however, miniaturization of the controls (buttons) which are eventually scaled with the overall size of the earlier music player may cause difficulties while controlling the products since it no longer fits to users' hands in the same way.

In this section, Apple's iPod is selected as a leading example to explain the transformations that MP3 players have undergone in the last decade.

In 2001 Apple introduced 'iPod' (Figure 3.13) with *a slogan* "1000 songs in your pocket" together with iTunes digital jukebox software. The compatibility of the product and the software is extended to be used with Microsoft products with the second generation iPod (Apple Inc., 2014).

Figure 3.13 The original iPod (Apple Inc., 2014)

In 2003 Apple took an important step for the integration of purchase of music into the iPod's product service system by launching iTunes Store together with the third generation iPod (Apple Inc., 2014). Although the customers still could purchase the whole album, this 'song based' purchasing system (Apple Inc., 2014) changed the way we feel about owning an album which generally has a story, concept or common sound within its tracks.

Year by year Apple upgraded and provided variations of the iPod by minimizing its size (iPod Mini [2004], iPod Shuffle [2005], iPod Nano [2005]) (Figure 3.14), adding new play modes (e.g. iPod Shuffle), by adding video playing options, providing wearability (iPod Shuffle with built-in clip). The circular layout for the main controls (volume up/down, previous-next, reward-forward, pause-play) is repeated in every version until the introduction of iPod touch (2007) (Figure 3.15) with particular technological features such as multi touch controls and built-in wireless network (Apple Inc., 2014) directly transferred from iPhone that had been released in the same year. Latest models of iPod Touch with "FaceTime video calling, HD video recording and Game Center" were almost iPhones without call-functions (Apple Inc., 2014).

Figure 3.14 First iPod Mini (2004), iPod Shuffle (2005) and iPod Nano (2005) (Apple Inc., 2014)

Figure 3.15 First iPod Touch (2007) (Apple Inc., 2014)

The same transformation from button-based controls to touch screen interface was also applied to new tiny iPod Nano, whereas the tangible controls of iPod Shuffle remained. It can be claimed that the wearability provided by the built-in clip in iPod Nano for accessibility to the controls contrasted with the small touch screen that requires much more visual attention in mobile listening (Figure 3.16).

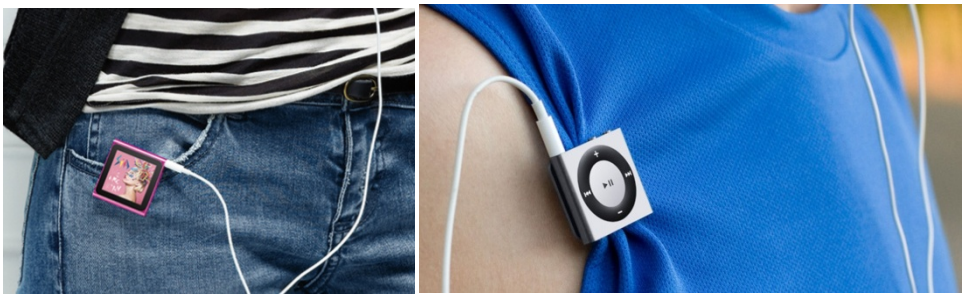


Figure 3.16 iPod Nano (2010) and iPod Shuffle with clip (2010) (Apple Inc., 2014)

The latest generation iPod Nano (7th generation, 2012) combines gestural interactions performed on the multi-touch screen and a control button where users can perform main controls without dealing with the screen.

Figure 3.17 iPod Nano (2012) (Apple Inc, 2014)

3.9 Current Trends

The current trends in mobile listening devices include integration of the music players and headphones, smart headphones, listening via wearable computers, touch gestural controls on the surface of the headphones and customization.

3.9.1 Integration of the Music Players and Headphones: Wireless Solutions

One of the current trends in mobile (listening) devices is to decrease the number of products to deal with, so that users can divide their attention to other tasks as well. With regards to mobile listening devices there are a variety of consumer products in the market which enable users to store and control music in/on their headphones and earphones. The integration of music players with earphones also offers a wire-free use, which targets sportsmen and sports women as can be seen in Figure 3.18. There are also headphones based on this idea, designed to be more appealing to mobile city dwellers (Figure 3.19)

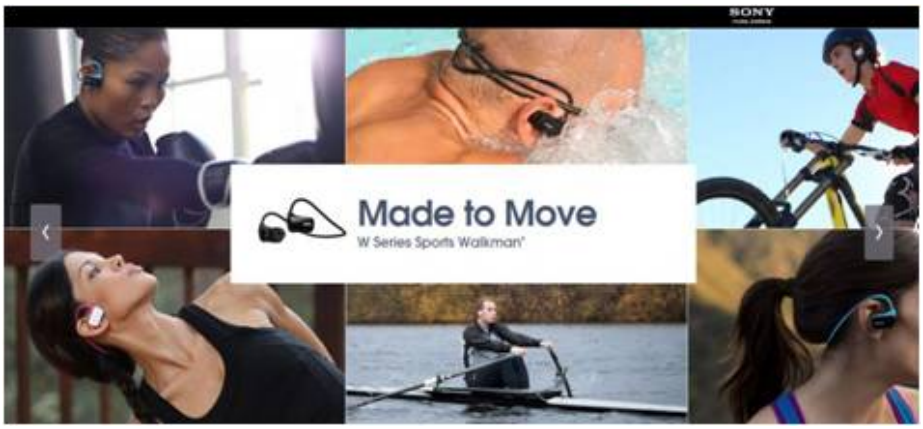


Figure 3.18 Mobility enhanced by the combination of Sony MP3 player with earbuds (Sony, 2014)

Figure 3.19 Sony NWZ-WH505 wireless headphones with music storage and controls (Sony, 2014)

3.9.2 Smart Headphones

The integration of music player and earphones is not necessarily a physical integration. Accessing music through the headphones can also be realized through the 'internet of headphones' by enabling a wireless connection of headphones to the music sources. A Kickstarter project proposed by a company called STREAMZ promises "smart streaming headphones" which enable users to listen to music from multiple sources including online radio stations like Spotify thanks to its built-in Android processor, WiFi and Bluetooth connectivity (STREAMZ, 2014).

3.9.3 Listening via Wearable Computers: Google Glass

Google Glass (Figure 3.20) constitutes a great example for contemporary wearable computers which are also able to access any music via internet. In terms of interaction it differs from other smart applications with its voice command controls.

Figue 3.20 Listening to music through Google Glass (androidandme.com, 2013)

3.9.4 Touch Gestural Controls on the Surface of the Headphones

Another development in mobile listening devices is transferring the controls that used to be performed on music players to the headphones with touch sensitive surfaces. In all headphones with touch gestural controls, volume up/down and skipping songs are performed in similar way by swiping finger vertically and horizontally. However, they have different gestures assigned to pause, ranging from double tap on the touch sensitive surface (Figure 3.21) (Samsung, 2014) to taking off headphones (Figure 3.22) (Parrot, 2014).

Figure 3.21 Samsung Level Over headphones: Gestures for the main controls (Samsung, 2014)

Figure 3.22 Parrot Zik Headphones with touch gestural controls (Parrot, 2014)

3.9.5 Customization

All examples that this Chapter has gone through consist of mass-produced devices and customization is only achieved through specialization of the products for specific user group or task, like in the example of "My First Sony" Walkman series for children in primary colors or in the example of Sony wearable MP3 player for sportsmen/women. Another common trick is to provide different color options. Nevertheless, the latest technology grants the producers the opportunity to offer different levels of customization to their users. 'OwnPhones' which is another Kickstarter project waiting for to be funded will be mentioned here to illustrate the diverse ways to customize a product and product experience.

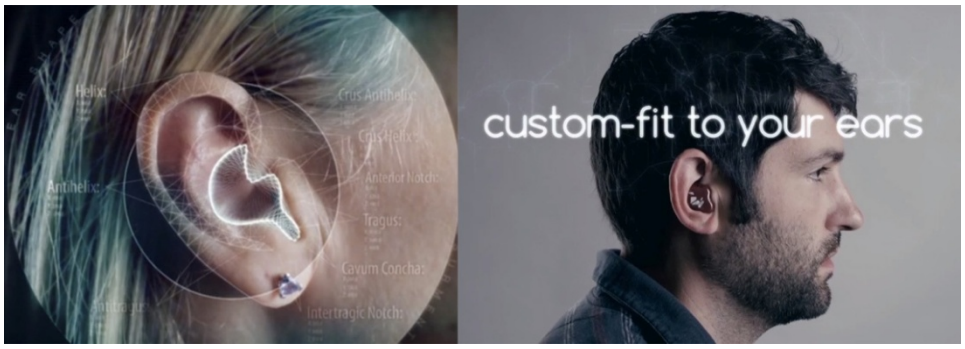


Figure 3.23 Custom-fit to the ears of each user (OwnPhones, 2014)

Customization through ergonomic fit to ears: 'OwnPhones' are defined as "3d printed wireless earbuds custom fitted to your ear." Depending on the fact that everyone has his/her own shape of ear the company provides an application which

turns a smart phone into a 3d scanner to get the digital 3d model of the ear. This way company can manufacture an ergonomic-fit earbuds with 3d printing technology (Figure 3.23) (OwnPhones, 2014).

Figure 3.24 Customization of 3d-printed earbuds in the form of jewellery (OwnPhones, 2014)

Customization through the appearance: OwnPhones exploits the advantages of 3d printers to manufacture complex shapes. This leads to an unprecedented typology of earphones in the form of jewellery as can be seen in Figure 3.24.

Customization of what you hear: Another current trend in earphones with wireless connection is to provide a smart phone application by which users can choose the level of noise cancellation (OwnPhones, 2014; Parrot, Audio Suit 2014) (See Figures 3.25 and 3.26) and identify the sounds to be filtered or not, thanks to the built-in digital signal processor (OwnPhones, 2014). It can be regarded as a significant attempt to empower users to deal with the two simultaneous sound worlds. For instance, in a train station users can both enjoy music and hear announcements through the earbuds at the same time. In addition to this, OwnPhones also enable users to switch off one of earpods to listen to music on one, the ambience on the other piece.

Figure 3.25 Activating real world notifications through the app. (OwnPhones, 2014)

Figure 3.26 Parrot Auido Suite App where users activate or deactivate Active Noise Cancellation, Concert Hall Mode and adjust audio frequency through Equalizer (Parrot, 2014).

3.10 Summary

This chapter has initially elaborated how practice of listening is transformed into mobile listening and how music players are transformed into 'personal' music players. While the mobility is achieved through the increased portability of the products; personalization is realized with the privacy brought by the combination of headphones and portable music players within Walkman. Therefore, it constituted an ideal product for city dwellers who wish to carry their music to everywhere.

This Chapter also illustrated that the introduction of new sound recording technologies and new sound storage media such as cassettes and CDs has offered new practices and interactions particular to that media. The changes in these practices can be exemplified with how skip forward and back through forwarding and rewinding the songs in cassette players were altered with Discmans with single press on a button to advance songs.

The overview of the evolution of mobile listening experience not only comprises the changes in interactions or aesthetics of these interactions, but also the meanings attributed to the products. For example, carrying boombox on shoulders both exemplifies user-product interactions and the signifying practices associated with particular sub-cultures.

The overview has continued with the introduction of MP3 and MP3 players. It has accounted for how users' interaction with storage media (cassettes and CDs) as one of the most important elements of interaction is dematerialized. This has not only eliminated music storage media physically, but also decreased the size of the music players to a great extent. This scale-down contributed to the portability of music archive as well as the music players. The early MP3 players are followed by wearable solutions to deal with the problems concerning the cables and where users carry their music players. In some designs this is achieved by the combination of MP3 players and the earphones on head, which actually eliminates one more tangible piece of mobile listening, which is the MP3 player itself.

Currently smart phones with audio playback functions have become the main mobile listening devices, since they are always ready at hand and enable users to access any songs via internet connection. This shows why most of the products or projects presented in 'current trends' mainly involve the developments in *headphones*.

One may question what the point of discussing music players which are already been integrated to another mobile devices is. Here it should be mentioned that what is meant by enhancing mobile listening experience in this thesis is not proposing ideas for alternative music players. It rather focuses on the way we deal with listening related controls no matter which media is used to access music. Yet, it also examines the possible transformation of the contextual elements into mobile listening devices under 'embodiment' of controls.

Above it is mentioned that headphones are made smarter by enabling them to access music through internet. With touch gestures, headphones as embodied elements of mobile listening have become the main means of interaction. This can be approached as if the number of mobile listening tools is reduced into one with a very functional point of view. However, it can also inspire people to exploit other embodied elements of mobile listening and accompanying activities to improve the interface between users and music.

After having elaborated *the products*, the following chapter will render the methodology of this thesis and present the ways to get insights from *the users.* It is followed by a discussion of aesthetic ways of *interaction* of future mobile listening media which will later be added to the timeline of 'evolution of mobile listening experience'.

CHAPTER 4

METHODOLOGY

4.1 Introduction

If someone asks a person to illustrate mobile listening in public environment what should he/she include in the picture? Would it be enough to draw a user walking in a street, with an MP3 player at hand and headphone on ears? What about the user's clothes, cars on the street, other people walking around? Another important question is if a picture is enough to illustrate everything. What about the way user travels, the things he/she does with his/her mobile listening device? Which meanings does he/she attribute to this activity? Do these meanings have something to do with what we call culture?

All these questions refer to specific aspects of user experience which goes beyond the user-product interaction. The questions can be conceptualized under the terms "context, social interactions, aesthetics of interaction, experience of meaning/sense-making, cultural signification", which have been mentioned in the literature review in detail. The underlying questions remain the same while constructing the methodology of this thesis, which comprises the fieldwork conducted in real context of use. In the literature review, Chapter 2, the significance of context was justified with two main reasons, which are, to understand the complex relations among users and products; and to discuss the potentials of contextual elements for contribution to the aesthetics of interaction. It is these two concerns with regard to the context of use that guide the formulation of the field studies of this research. Therefore, this chapter will discuss how fieldwork was organized first to uncover the contextual factors related with user, product and the environment; second to reveal the potential of contextual elements to design new forms of aesthetic interactions.

First, this chapter will argue that it was essential to reflect on users' past and current experiences to reveal the main qualities of user-product product-product user-user interactions. Discussing the effects of the public context on these interactions required a study which is conducted in real context of use with real users and surroundings.

Regarding the context of use, it should not be ignored that the influence of context depends on the type of the activity as mentioned in Dourish's (2004, p.5) definition of context as "a relational property between objects or activities". Since mobile listening is an activity that always accompanies other public activities, the ideal field study demanded the inclusion of different activities in public environment. These activities could be easily defined and put in an order since mobility of users within a public environment inevitably determined the type and order of the activities.

Secondly, discussing the potentials of the context in terms of aesthetics of interaction is something which points out the future and it requires a specific type of field study which can reveal user's expectations. Therefore, it was decided that fieldwork should also include a real-time activity in which users themselves can explore the alternative ways of controlling the music through the use of daily objects and gestures.

To summarize, the methods used in this research gave users the chance to *talk* about their experience, to *show* what they really mean, and to share how they would *want* this experience to be. Hence, the qualitative research was organized in three main studies:

- Study 1: Telling about the journey
- Study 2: Living in the journey
- Study 3: Dreaming about the journey

Since it is time to enter into the field; the chapter will prefer to use the daily term 'Journey' corresponding to 'mobile listening experience'. Journey as a term is also inspired by customer journey (mapping) as a research tool which is used to gather data about customer experience for service design projects (Abbing, 2010). Aside

from this link, what really makes "journey" a term applicable to this study is its reference to the travelling activity accompanied by music.

4.2 Underlying Methodological Perspectives

Before going into details of the three main studies of fieldwork, this part briefly touches upon some methodological perspectives which inspired the organization of the research; namely "customer journey mapping" (Abbing, 2010) and the generative design tool, "Say Do Make" (Sanders & Stappers, 2013).

4.2.1 Customer Journey

Customer journey is a method to structure and conceptualize the customer experience. Here, a brief explanation of customer experience and customer journey will be provided to better exemplify how they have provided inspiration to construct the methodology of this thesis.

The emergence of the term 'customer experience' can be regarded as an outcome of the search of companies to find ways to develop their relationship with customers by providing better products and services. It is a holistic and process-oriented term that goes beyond the outcome-oriented concept of consumer satisfaction (Nenonen, 2008). While the latter focuses on the functionality of a service or a product, the former includes "all the moments of contacts and emotions during the experience" (Nenonen, 2008, p.57). In moments of contact the medium for the customer-company interaction is the touch point. A touch point could be the product itself, the shopping store or the service person, and within the customer-company relationship these moments of contact create a loop (Abbing, 2010) including all phases of product lifecycle from initial discovery to disposal.

If we take this loop as a customer journey –in some sources it is defined as the name of the method itself– the customer journey mapping is defined by Abbing (2010) as "the process of creating a graphical representation of the steps and stages a customer goes through to experience a product or service" (p.10). Therefore, it should be organized in a way that it adequately covers the flow of interactions and possible touch points.

These maps generally consist of a timeline shaped by those stages and particular categories listed under every stage. These categories may include positive or negative emotions, tasks, goals, the touch points and the ideal situation so that we can see if there is any potential for improvement of the product or service (Brand Driven Innovation, 2011). When it is conducted with more than one person it also gives an idea about how different people experience those phases and if there are any differences and commonalities.

4.2.2 Say Do Make

This tripartite study plan owns a parallel structure with one of the most re-owned generative design research frameworks, 'Say, Do, Make' developed by Sanders and Dandavate (1999) within the firm Sonic Rim.

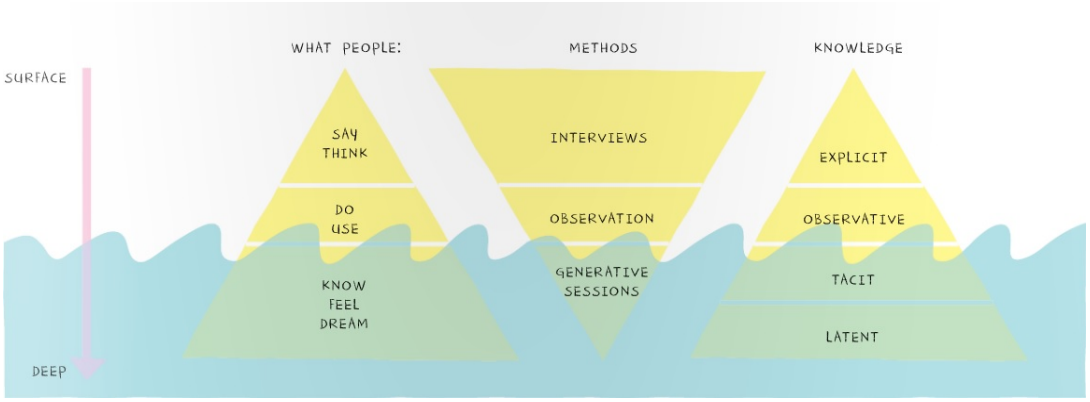


Figure 4.1 Levels of information acquired by different methods based on what people 'say, do, make' (Sanders & Stappers, 2013).

This framework lists the possible qualitative methods (see Figure 4.1) that try to gain insights from what people say and think; what they do and use and what they *know, feel and dream,* which are briefly grouped as Say, Do, Make by Sanders (Sanders & Stappers, 2013). These categories have a strong reference to time and they have a hierarchical order in terms of their potentials to help researchers to access different levels of knowledge (Sanders & Dandavate, 1999). For example, by listening and interpreting what people *say* and *think* through interviews "explicit knowledge" that mainly reflects the "memories", in other words, past experiences of people can be revealed (Sanders & Dandavate, 1999). On the other hand, observing what people *do*

and *use* is a real time activity that shows us their "current experiences" and helps us gain "observative knowledge" (Sanders & Dandavate, 1999). However, accessing the "tacit and latent knowledge" is made possible through the *make techniques* involving generative sessions to access deeper levels of users' expression and derive insights about their "ideal experience" (Sanders & Dandavate, 1999).

The three 'journeys / journey studies' in this thesis followed similar routes to the data by appropriating each study to the context of use and to the research by utilizing the most suitable methods. Detail descriptions and arrangements within the three phase fieldwork now follow.

4.3 Study 1: Telling about the Journey

Problem statement of this research was based on the previous observations of mobile listening activity, personal experience and the initial review in literature that depicts similar problems and proposes solutions to them. To draw a more objective picture of these problems, consultation on real users appeared to be imperative. Therefore in Study 1 customer journey mapping was utilized as a 'say' method. As mentioned above, mobile listening experience in public environment can be considered as a literal journey accompanied by music. The scope of this research is the controls and aesthetics of interaction of mobile music player device. Therefore all phases in the life cycle of music player(s) and the service provided with those products in purchase or maintenance were not included as stages of the journey. Instead, the stages were limited to the mobile listening activity in public environment itself.

Study 1: 'Telling about the Journey' can be briefly described as a session that was conducted with five participants, who together filled a chart on the wall with different coloured post-it notes for the purpose of identifying each participant's journey.

4.3.1 Participant Sampling

Although it is difficult to associate mobile listening activity with one particular user group, it can be claimed that teenagers and young adults constitute the majority of target market. All participants involved in the study were owners of mobile listening

devices, whose ages vary from 24 to 29. Each participant was an international student of the Netherlands' Technical University of Delft, Design for Interaction master's programme, where the author was an Erasmus exchange student for a semester during Fall of 2013-14. This international setting eventually increased the variety of answers as a result of the participants' different cultural backgrounds.

4.3.2 The Venue and the Equipment

The venue arranged for Study 1 was as a study room where the participants could discuss the chart together by sitting around a table and fill the chart hanged on the board with their post-it notes when they wish. This 90-minutes session was recorded with a video camera (Canon 500D) in case the participants wanted to express themselves by acting out their experiences instead of writing or drawing their concerns on post-it notes.

Table 4.1 The chart provided to the participants in Study 1 session

Stages of the Journey →	**Preparation process**	**Travelling with music**		**End of temporary listening activity**
		On foot	*Public transportation*	
Actions & related tasks				
Social interactions				
Negative experiences				
Positive experiences				

The chart consisted of columns for different stages in mobile listening and rows for particular categories. These stages are determined by considering the main steps of listening to music on the go as a daily urban experience, which starts with making the headphones and mobile music player ready, closing the door of our house (which is defined as "Sonic Door" by Thibaud [2004]), pushing in/tapping on the play button to let the music travel with us from that time on, travelling on foot or by other means of public transportation, and stopping listening to music having reached to our final destination.

The categories which were determined to be evaluated in each stage were actions and related tasks, social interactions, positive experiences and negative experiences. The

first category, 'actions and related tasks' tries to uncover user-product and product-product interactions. The second category focuses on social interactions and how the presence of other people affects the way we interact with the products. While the third category, positive experiences, invites participants to talk about the things they like about the use of the product; the fourth category, negative experiences, expects the participants to mention any problems they come across.

4.3.3 Protocol of the study

The study followed particular steps:

- It started with the explanation of the aim of the study to the participants and a warm-up talk about the mobile listening devices the participants had been using, how often or when these devices were used.

- The chart and the titles written for each stage and categories were explained in detail.

- The participants are given post-it notes and pens and asked to fill the chart by writing their past experiences on post-it notes and paste them on the related parts of the chart. Each participant was given a different colour post-it note to be able to follow their individual journey as well as to track the differences and commonalties among their experiences easily.

Conducting this study with a group of people brought some advantages. For example, when one participant explained his or her own experience for each category and each stage to the others, the other participants also felt encouraged to reflect on their own concerns by taking these comments as a reference. The answers of this multi-national group also reflected some particularities of their national contexts.

4.4 Study 2: Living in the Journey

The aim of Study 1: 'Telling about the Journey' was to let the participants of the fieldwork reflect on their past mobile listening experiences. It helped understanding the participants' main concerns, and seeing to what extent they were related with the product they used (i.e. music player) or the public context of use.

Study 2: 'Living in the Journey' aimed at giving the participants the chance to reflect on their current experience by directly using the product in the real context. The study was conducted with four specific products (see Section 4.3.1); each of which had varied features and unique way of interaction**.**

4.4.1 Selection of the Products

The scope of this research is the controls of mobile listening devices and their aesthetics of interaction through embodiment within the public context of use. Therefore, the products which were selected to be tested by the participants in of this study have their own particular controls and had different levels of embodiment. The motivation behind Study 2 was also to understand how the mobile listening devices with unconventional application of interactive technologies were perceived by the participants in addition to uncovering the disadvantages and advantages of the products considering mobility and the dynamics of public environment.

Giving the participants one of these products with hitherto known properties enabled to conduct a more controlled study, and to gather comparable data. Consequently, the products chosen for the study were: iPod Shuffle (fifth generation), iPod Nano (seventh generation), Sony NWZ-W273 MP3 player and Rhythmz Blu HD headphones.

4.4.1.1 Product Features and Reasons behind their Selection

This section presents general description, main controls and additional features of the five selected products, along with the specific reasons behind their inclusion in the study. What makes each product worth selecting or differ from other products are their different interfaces: button-based controls of Apple iPod Shuffle, graphical user interface and multi touch screen of Apple iPod Nano, eyes-free button-based controls of wearable Sony NWZ-W273 MP3 player, and touch-gesture controls of Rhythmz Blu HD headphones.

1) Apple iPod Shuffle (5th generation)

Apple iPod Shuffle, as one of the generic MP3 player models in the market is included to the products to be analyzed in this phase (See Figure 4.2). Compared to

other MP3 players, its design has relatively less complex details: a tiny square aluminium body with a clickable control pad on the front and with a clip on the back. Users can clip it to their clothes, bags and other accessories when they want to free their hands. This makes the product not only portable but also a wearable one (Apple, 2014).

Figure 4.2 iPod Shuffle (Apple, 2014).

Main Controls:

A click on the centre button of the circular control pad functions as play and pause. Outer buttons are used to skip forward or back and to adjust volume. On the top side of the device there is a three-level switch which is used to activate shuffle mode, playlist mode and to turn off the product.

Additional Features:

Audio feedback is used for several purposes in iPod Shuffle. If users press the 'Voice Over' button on the top, they can hear the details of the track such as the name of the track or artist. It also gives users chance to switch among playlists whose names are announced by the device.

Reasons behind its Selection:

- Its generic layout of tangible controls that is worth testing to have an idea about the interactions of current products which own similar controls.
- It gives the researcher the chance to find out if wearability contributes to mobile listening experience in public environment or not. The piece of

clothing or other personal belongings where the users prefer to attach the device can show us the places that users feel most comfortable to carry and control the device in public context.

2) Apple iPod Nano (7th generation)

Apple iPod Nano can be differentiated from other products with its multi touch screen through which users can navigate through the menu, view related information about the tracks such as album cover; and control the songs via its graphical user interface (Figure 4.3). Its thin, lightweight aluminium body also has a tangible button on the left side to access main controls without dealing with the screen. It comes with its own ear pod.

Figure 4.3 iPod Nano button-based controls (Apple, 2014).

Main Controls:

The tangible controls on the left are grouped in one button. Pressing up and bottom parts of the button functions as volume up/down. The middle surface of the button is used for play/pause. However, this part can perform different functions according to the number of clicks: whereas pressing twice means skipping forward, pressing it three times means skipping back.

The layout of the controls in graphical user interface can be seen in Figure 4.4. Play, pause, skip forward/back are symbolized with icons to be tapped, while adjustment of volume is realized through a digital slide.

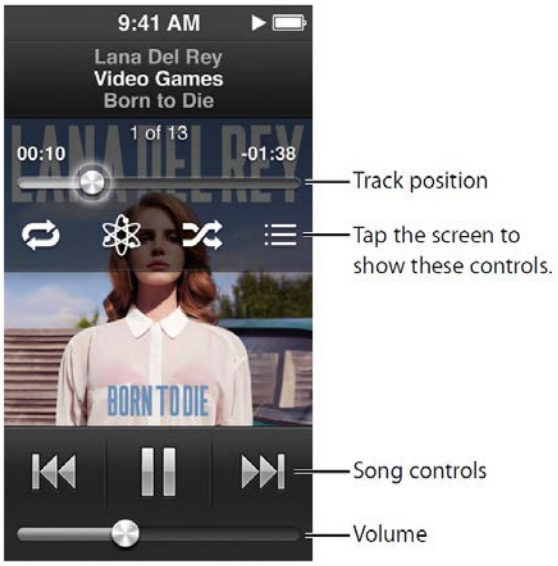


Figure 4.4 iPod Nano GUI controls (iPod Nano User Guide, 2014).

Additional Features:

iPod Nano provides some extra functions aside from listening to music. Song options are not restricted to the user's music archive in the device; it functions as an FM radio as well. The middle part of the tangible play/pause button gains another function not only with the number of clicks but also with the duration of the click. When it is pressed longer, it gives audio-information about the name of the song, the album, and the artist. This way it eliminates the need of looking at the screen to see the song info. Furthermore, it can be synchronised with Bluetooth devices such as Bluetooth headsets to obtain a cable-free use.

Similar to the main controls, shuffle mode can also be activated without using graphical user interface. Shaking the device as shown in Figure 4.5 is determined as a device-based gestural control for shuffling the songs.

Figure 4.5 Shuffling songs by giving iPod Nano a quick shake (iPod Nano User Guide, 2014).

Reasons behind its Selection:

- Inclusion of both tangible buttons and multi touch screen provide opportunity to compare these two types of controls within one product. It is also expected to give insights about what kind of controls are preferred in each condition.

- It is the least wearable example among the selected products; it points out the possibility of seeing how users deal with a non-wearable device while listening on the go.

3) Sony NWZ-W273 MP3 player

Sony NWZ-W273 MP3 player draws attention with its unconventional design that combines MP3 player with earbuds. Such combination contributes to wearability and cable-free use, which eliminate the obstacles for bodily movements and make the product more appealing to sports lovers. Its waterproof body also enables swimming and listening simultaneously. Sony presents this mp3 player as a wearable, waterproof wok-out partner (Sony, 2014).

Main Controls:

The controls of the product are separated into two sides of the MP3 player: while the right side is spared for skip, play/pause, on/off button and hold slide; left side is spared for volume up/down and shuffle/playlist mode button as can be seen in Figure 4.6.

Figure 4.6 Combination of MP3 player with earbuds: Sony NWZ-W273 MP3 player (Sony, 2014)

Figure 4.7 Eye-free controls of Sony NWZ-W273 MP3 player (Sony, 2014)

Additional Features:

Some buttons gain different functions according to the duration of pressing. For instance, when play button is held down for 2 seconds "ZAPPIN" function is activated, which helps users to navigate through songs just by listening main melodies and select one according to their pace (Sony, 2014). Another multi-functional button is the skip button which also enables user to advance folders when it is pressed longer (Sony, 2014).

Reasons behind its Selection:

- Its eyes-free, button-based controls which can only be performed on ears appear as a distinctive interface is worth testing.

- Although it is specialized for sports people, its wearable, wire-free and hands-free (when it is not controlled) use also carries potential for 'mobile' listeners, especially pedestrians. The study created a chance to see what the reflections of these advantages would be on activities performed in public environment.

- The combination of music player with earphones can be given as an example of 'embodiment'. This detail creates a new typology of music players as wearable accessories. Whether this combination enhances the interaction or not is one of the questions to be answered in Study 2.

4) Rhythmz Blu HD Headphone

The main motivation behind choosing this Rhythmz Bluetooth headphone in this study is its touch gesture controls. Controlling the songs by swiping the outer touch sensitive surface of the Bluetooth headphone both enhances wire-free usage and provides a unique way of interaction.

Figure 4.8 Rhythmz Blu HD Headphone-touch gesture controls (Rhythmz, 2014).

Main Controls:

Users can raise or lower the volume by swiping up or down in vertical axis; and advance songs by swiping the touch sensitive surface in horizontal axis (Rhythmz, 2014) as can be seen in Figure 4.8.

Unlike adjusting volume or skipping back and forward, there is no special gesture for playing the songs. Playing should be initiated in the main music player device. To pause and then play the song again, users can click the tiny button on the right once.

Additional Features:

Like many other Bluetooth headphones, it enables users to have phone calls with its built-in microphone when it is used with a mobile phone.

There is no other additional feature regarding the interface unless we talk about the multi-functional play/pause button. Depending on the time spent on pressing the button, it is utilized for turning the product on/off and or pairing it with another Bluetooth enabled device.

Reasons behind its Selection:

- The product offers a very distinctive aesthetic experience by the gestural controls. This can be regarded as an upgrade of headphones and utilization of an embodied piece of mobile listening as the main medium of control. Therefore this study aims to look at users' reaction to this unconventional interface.

- The force applied to the surface while swiping fingers on the touch sensitive area or the speed of the gestural movements are among the variables to obtain the ideal gesture based interaction. The study provides an opportunity to see how users deal with these variables while listening on the go.

- The product is expected to be used with a Bluetooth device such as mobile phone which has its own controls for playing music. In this study it can be observed which type of controls users prioritise in particular conditions.

- Swiping finger on headphone's surface to control songs needs time to be regarded as a 'signifying practice'. This study also questions if there is a reluctance to perform these controls in public environment.

5) Urbanears Plattan Headphone

Urbanears Plattan Heaphone (See Figure 4.9) was not among the main products which were evaluated in this study. It was selected to provide users an alternative to the earphones which are already given with the music players (iPod Nano and iPod Shuffle).

Figure 4.9 A man wearing an Urbanears Headphone (Urbanears Streetsyle on Pinterest, 2014).

Urbanears Plattan Headphone has a remote control piece which is only compatible with particular mobile devices. It includes one button that works as play or pause with one click, skip forward with two clicks, and skip back with three clicks. When used with iPods the functions of Voice-Over button are also transferred to this remote. The controls of the device versus this remote control create a chance of comparative analysis between these two types of interface. Although it was an optional product to be used, its interactional contributions or limitations will also be discussed in the analysis part.

4.4.2 Participant Sampling

A different set of participants were sampled for Study 2. The study was decided to be conducted with sixteen participants whose ages ranged between 24 and 32. This way each of the four products could be used by four different participants. The selection of participants can be classified as snowball sampling since mobile listening is a

common experience which does not really necessitate finding experienced people to consult on. There are no strict criteria to match the products with participants either. However they are distributed in a way that each product was used by at least one male and one female participant.

4.4.3 Decision of the Actual Journey Route & Activities

Mobile listening can be regarded as a daily public activity; therefore the experience is always open to observation. However, mobility and being in a public environment create challenges for the observer as well as the people listening to music. Explaining the "Do Techniques", Sanders and Stappers (2012) mention that there can be limitations to achieve the optimum level of unobtrusiveness while observing and recording because of privacy issues and the practical conditions. Even though one can observe and record users' activities without problem, there is a possibility that the observer's reasoning of the particular behaviours of users may not match with the users' real concerns.

Therefore, the second study was planned in a way that participants could act naturally while listening their music and soon after the completion of their tasks they could explain their experience with mobile listening devices. Therefore, the journeys with a particular route within the city of Ankara, involving different forms of mobility such as public transportation or travelling on foot were organized. The participants were asked to perform series of activities or tasks that mostly required social interaction with other people and division of their attention among several tasks. These activities were determined with reference to the main themes derived from Study 1. Kızılay district is selected for this study since, as one of the city centres; it was believed to be known by the participants quite well. The selected destination also allowed them to complete all the activities in a defined area within 45-60 minutes including their travel time to Kızılay.

4.4.3.1 Protocol of the Study

The route and the activities were explained in order with an illustrated map (Figure 4.10). This map and the product to be tested were given to the participants a few days before the journey to enable them to get used to the product and its controls. After

this, what all users have to do was listening to music while travelling and following the steps on the map on a planned date.

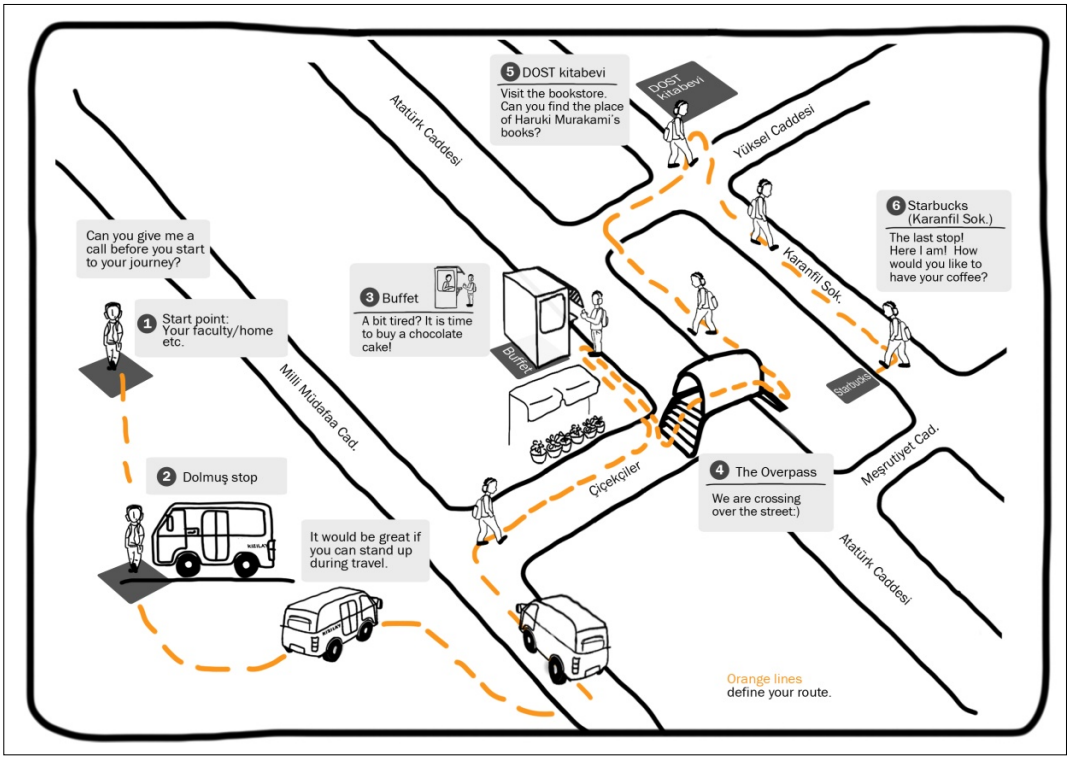


Figure 4.10 The map showing the route and ordered activities to the participants as prepared by the author

4.4.3.2 Post-Interview

All journeys were followed by semi-structured interviews (See the interview questions in Appendix A and B). The questions covered what the participants did at each step they went through, which controls they used (had to use) regarding the dynamics of each activity, what the ideal interaction for each activity could be, what they liked and disliked about the product and its controls and what changed about the use of the product in public environment compared to home (if they used it at home as well). These interviews were conducted as the last activity of the journey so that the participants can remember their interaction with the products or the context of use, and act those interactions with the products again if necessary. Therefore, it can be claimed that, Study 2 aimed at accessing the data about current experiences of users by *appropriating* "Do" stage through the users' direct participation in this pre-defined *journey*.

4.5 Study 3: Dreaming about the Journey

Having gathered data about previous mobile listening experience of people in and having let users reflect on their real-time experience in real context; last study aims to conduct a one-hour generative session (as a 'Make' method) where users can explore the potentials to enhance mobile listening experience by making use of contextual elements. This study aimed at demonstrating the patterns of physical manipulation of objects and bodily movements preferred by users and exploring the potentials of these controls in terms of aesthetics of interaction as well as their applicability to the context.

4.5.1 Participant Sampling

'Dreaming about the Journey' was conducted with four volunteer users of Study 2. Although there was no specific criterion for the distribution of gender; the study involves at least one participant from each gender to increase the diversity of potential accessories or clothing to be used as 'toolkit' in generative session.

4.5.2 The Venue and the Equipment

A classroom at METU Department of Industrial Design with enough space for discussion on a table as well as role-playing (especially specific bodily interactions) was booked for Study 3 (Figure 4.11).

Figure 4.11 The set-up of the venue

The table was filled with mobile listening devices and daily objects that we somehow carry and wear while travelling in public environment with music (Figure 4.12). The participants were kindly asked to come to the venue with their outdoor clothes like jackets or raincoats and their accessories. This way the variety was increased and users had the chance to reveal the potential of their personal belongings for controlling music.

Figure 4.12 Daily objects provided in the venue

The warm-up slides which included photographs from Study 2, 'Living in the Journey study' and the list of main controls (play, pause, skip, volume up/down) and possible additional controls were projected on the wall to help users to think of alternatives for these controls together with the dynamics of the context.

The session was recorded with both video camera (Panasonic HDC-SD 40) and sound recorder (Samsung Galaxy SIII) by taking the consent of participants. The close-up shots were also taken with a camera to better visualize the details of certain user-product interactions.

4.5.3 The Protocol of the Study: Four Intertwining Stages

The session was started with a warm-up presentation which overviews the activities done in Study 2 'Living in the Journey' with photographs taken in each stop (Figure 4.13). For each activity, highlights from the interviews were also shared with participants in order to get them more into the topic.

Figure 4.13 Photos documenting where some of the activities take place in 'Living in the Journey'

First stage of 'Dreaming about the Journey' can be named as 'overview of *unintentional/non-instrumental interactions'*. Unintentional/non-instrumental interactions refer to the interactions which do not own a functional purpose such as "playing with or caressing the product" (Desmet & Hekkert, 2007, p.58). In other words they are for the sake of exploration rather than operation. Playing with the cable of earphones and swiping fingers on textured surfaces of a music player can be given as examples to non-instrumental interactions in mobile listening.

However this part of the session also aimed to explore some acts which have functional purposes but are not realized through the designed interface. These alternative interpretations can be illustrated by directly taking off headphones/earphones in case of a conversation or pulling the earphone jack out of the MP3 player when a phone call is received. These actions can be regarded as alternative ways of pausing the music.

Hence, referring to Study 2 and participants' previous mobile listening experiences; in this stage, users were asked if there were any other cases illustrating such *non-instrumental interactions or alternative ways of performing controls*. To make these terms clearer to the participants, the examples given above were illustrated in the presentation (Figure 4.14 and Figure 4.15). The motivation behind this stage was to consider the potentials of these actions to be the real controls of mobile listening devices.

Figure 4.14 Controls beyond the interface: alternative ways to pause listening

Figure 4.15 Illustration of non-instrumental interactions with headphone cables

The following stages of 'Dreaming about the Journey' phase were quite parallel with the literature review on different forms/levels of embodied interactions.

In the second stage of this generative session, *utilization of daily objects*, participants were asked: "If you were able to control music through daily accessories or clothes that you use or wear while mobile listening, how would you do that?" In addition to mobile listening devices, the objects provided in the venue included some mobile listening related products such as bags or jackets which are utilized to carry music players. There were also other daily elements which users eventually wear and carry while travelling with music such as watches, jewellery, glasses, umbrellas, key chains, hand gloves and so on. (Figure 4.12)

In the third stage, *utilization of bodily gestures*, participants were asked to focus more on bodily movements to control music including movements of hands, fingers, arms, legs, heads, eyes, hair and even facial expressions.

The final stage, *controls beyond the limits of technology*, aimed to encourage users to express themselves and explain their expectations or dreams beyond the limits of technology. Therefore the last question directed to the participants was: "If technology enabled everything, how would you control the music while travelling?"

So far, within Methodology chapter, the organization of this tri-partite fieldwork, Telling about the Journey, Living in the Journey and Dreaming about the Journey was explained in detail by touching upon the practical conditions of each study as well as their expected contributions to the research.

The following chapter, Chapter 5 'The Results and Analysis of the Fieldwork' will reflect on the findings of these studies and analyse mobile listening experience in a comprehensive way to derive insights for the design of future mobile listening interactions which will become parts of new journeys.

CHAPTER 5

THE RESULTS AND ANALYSIS OF THE FIELDWORK

5.1 Introduction

As articulated in detail in Chapter 4, the fieldwork of this thesis was organized in three main studies, namely:

- Study 1: Telling about the Journey
- Study 2: Living in the Journey
- Study 3: Dreaming about the Journey

Earlier chapters already underlined that the thesis approaches 'context' both in terms of its effects on mobile listening experience as well as its potentials to enhance users' interactions with mobile listening media. Henceforth, the first study 'Telling about the Journey', and the second study 'Living in the Journey' have tried to find out, classify, and discuss the effects of the context on mobile listening experience by referring to users' past and current experiences of listening to music in public domain while 'on-the-go'.

To achieve this, Study 1 made use of customer journey mapping for participants to reflect on their mobile listening experience through different stages of their journey. Then, Study 2 was conducted in a real context of use. The participants were asked to test particular mobile listening products in a particular journey route while completing several pre-defined public activities/tasks at the same time. The study aimed to reveal the relationships between different user interfaces and the dynamics of the public context of use. Study 3 explored the potentials of contextual elements for aesthetics of interaction rather than listing the effects of the context on mobile listening experience. It was a generative session in which the participants were

expected to dream of alternative interactions for the controls of future mobile listening media by re-conceptualizing daily objects and gestures.

This chapter will analyze this tripartite fieldwork by providing the analysis overview, results and discussions of each of the three studies. The analysis will also reflect the progressive character of the fieldwork by discussing the contribution of each study to the organization of the following one.

5.2 Results and Analysis of Study 1 'Telling about the Journey'

Study 1 'Telling about the journey' was arranged as a session (Figure 5.1) which was conducted with five international participants who filled in the same chart on the wall with different coloured post-it notes to share their previous mobile listening experiences, in other words, their past journeys (see Table 5.1).

Figure 5.1 A snapshot from 'Telling about the Journey' session

Table 5.1 The chart provided to the participants in Study 1 session

Stages of the Journey →	**Preparation process**	**Travelling with music**		**End of temporary listening activity**
		On foot	*Public transportation*	
Actions & related tasks				
Social interactions				
Negative experiences				
Positive experiences				

The chart was prepared in a way that the participants can recall all the stages of their [listening to music] journeys. Hence, the first stage was determined as *'preparation process'* in which users get ready for listening to music by following particular steps such as plugging the headphones into the device, deciding what to listen, and putting/attaching the music player in specific places of their bags or in their pockets. The following stage was *'travelling with music'* which may include travelling on foot, or use of public transportation (e.g. metro, bus) that considerably affects how users deal with the controls of the music player device. Finally the last stage was *'end of temporary listening activity'*.

For each stage the participants were asked to fill the information for four different categories on the chart: i) actions and related tasks; ii) social interactions; positive experiences; and, negative experiences.

> *Actions and related tasks:* the participants elaborated the *user-product* and *product-product* interactions: they were guided by questions covering the way they preferred to carry and control their own products.
> *Social interactions:* the participants were encouraged to uncover the effects of presence of other people in the way users control their products.
> *Positive experiences:* the participants were expected to mention the aspects that they like about the way they interact with their products.
> *Negative experience*s: the participants were asked to mention about the related problems they face in each stage of their mobile listening experience in public environment.

For each stage, after brief discussions in the group, the participants filled the chart on the wall with the post-it notes and they reflected on their own mobile listening experiences. The main goal of the study was to detect the key concerns of users related with mobile listening activity in public environment; for example, to understand in what extent they were related with mobility and presence of other people ('public' context of use).

5.2.1 Overview of the Analysis

The analysis process of Study 1 started with the transcription of the participants' writings on the post-it notes (Figure 5.2) into a Microsoft Excel spreadsheet (Figure 5.3) with a similar appearance (e.g. similar table format, different colors post it notes, etc.) to better assist the analysis.

Figure 5.2 The chart filled by the participants

The responses of the participants were analyzed according to their contents by writing down the related keywords right next to the transcribed quotations (Figure 5.3). The themes and sub-themes of the study derived from these keywords. Then, each participant's quotations were re-categorized under these themes and sub-themes to see all related responses together. Since some quotations could be evaluated under more than a single theme, the other themes were also added next to the related quotation. This constituted a clear representation of the relationships among different concerns of the participants.

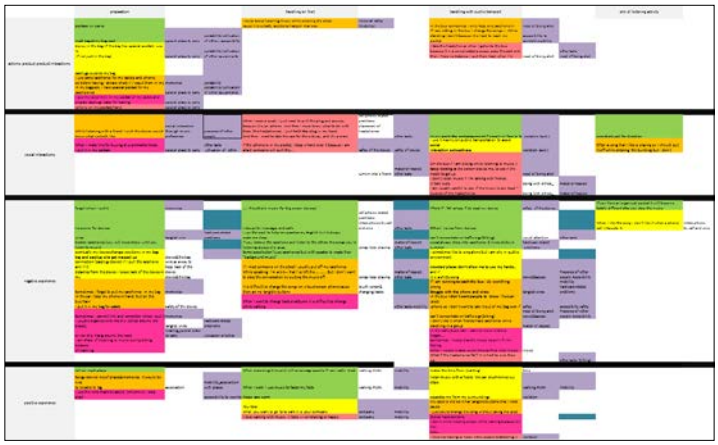


Figure 5.3 The transcript sheet and the content analysis of the data through purple-colored keywords attributed to the each quotation

5.2.2 Results

As a result of the analysis of the participants' responses, a) mobility, b) presence of other people, c) accessibility, d) portability, e) division of attention, f) hardware related concerns, and g) the mood of the user emerged as the main themes that reflect the users' key concerns in mobile listening activity in public environment. As can be seen in Figure 5.5 these themes and the sub-themes are highly interconnected.

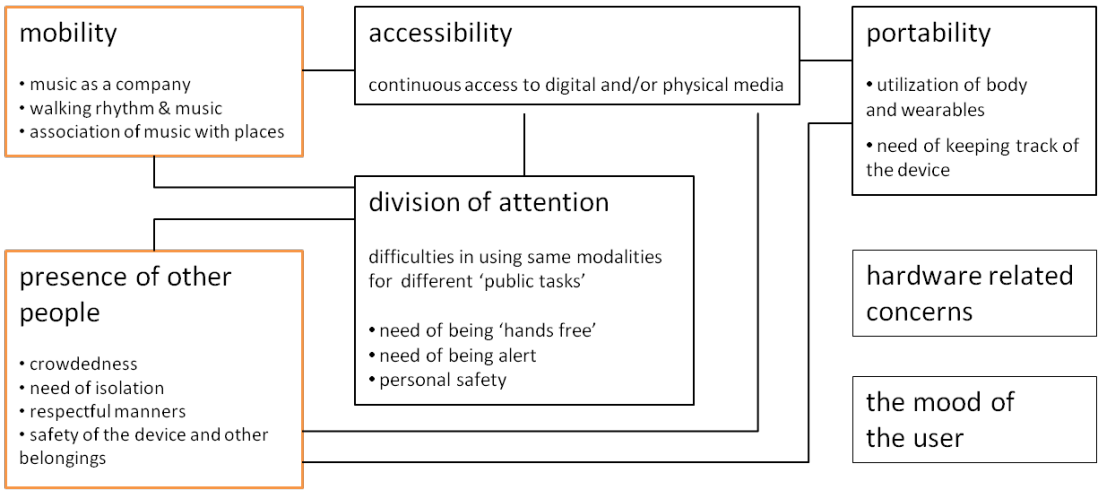


Figure 5.4 Main themes derived from 'Telling about the Journey' study

Each of these themes will now be elaborated with reference to their relations with other themes. Doodling made by some of the participants to express their ideas better will also be used as examples.

a) Mobility

The responses grouped under the theme of *mobility* mainly reflect how listening to music enhances users' travel. Music was defined as a travel companion and it was presented as a means for motivation while walking or doing sports to quicken the steps of users even if they were tired. It was also said that songs could be utilized to synchronize the steps with a friend. Besides these examples underlining the link between the *rhythm of the song and the walking pace*, a participant stated that "*songs remind me of places and memories. It would be nice to be able to tag...*" This shows how mobility of users enables them to construct meaningful relationship between the music and different places.

b) Accessibility

Before getting deeper into the theme *accessibility*; its relation with the themes *mobility* and *portability* will be briefly articulated. When mobility is considered together with the listening activity, the most essential thing for the user is to access music throughout his or her travel. The continuous access to music is made possible by the *portability* of both audio media and the music player.

The participants' concerns related with the *accessibility* mainly refer to being/not being able to reach and control a mobile listening device when needed. Such problems were exemplified by one participant who stated that *"the train is so crowded that I can't reach my iPod, I want to put the music off to be alert while getting off the train, but I can't."* Another participant mentioned how the cables of the MP3 player can be used to access the device by saying that *if I pull the earphone and if it gets detached from the device, I lose the track of my device in my bag."*

c) Portability

The theme *portability* is related with where users prefer carrying their mobile listening devices and if their preferences affect the *accessibility* and the control of the device.

All participants mentioned that they mainly utilize especially their clothes and bags to carry their MP3 players or phones (See Figure 5.5). In this regard, utilization of such daily portable/wearable items to make portable devices truly 'portable' gives some clues about possible embodiment of controls and feedbacks through these items.

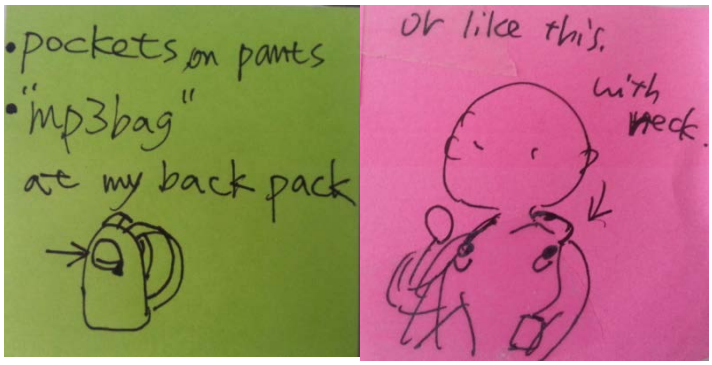


Figure 5.5 Different portability options illustrated by the participants

d) Presence of other people

Another significant theme considering the public context of use is *presence of other people*. *Crowdedness, our respectful manners towards other people, concerns for safety of the device* can be listed as sub-themes to explain how social interaction can affect the user-product interaction. All these sub-themes should be handled together with other themes and sub-themes. For example, being in a crowded place (e.g. train) can be an obstacle to access the mobile listening device carried in a pocket (portability). Presentation of 'crowdedness' as a concern for mobile listening is actually related with some participants' national context and their hometowns with high populations like Tokyo and Mumbai.

Some examples given by the participants for *respectful manners towards other people* can be listed as paying attention to the loudness of music not to disturb others, directly taking off the earphones when running into a friend, or to keep an eye on the person sitting next on the bus to be able to notice when he/she wants to leave. Such situations all create the necessity of controlling the sound.

Need of isolation -as another sub-theme- increases with the presence of other people and constitutes the main motivation behind mobile listening. One participant's note on post-its was *"I love not having to listen to other people blabbering :)"*

Lastly *safety of the device and other belongings* starts to become an issue in the public context. Depending on where users travel or walk, the concerns for the safety may alter; nevertheless, keeping a hand on music player in the pocket, or not taking iPod out of the bag in the bus can be given as examples of how people develop tactics to protect their devices in public environment. As can be seen in Figure 5.5 *safety concerns* can pose problems regarding the *accessibility* of the controls since they influence how mobile devices are carried.

e) Division of attention

Division of attention is another theme derived from the results. The comments of the participants showed that being mobile in public environment with lots of audio and visual stimuli results in difficulties in *division of attention*. The term refers to the

division of a sensory modality in different tasks. The concerns about not being able to hear, see, handle different things at the same time in public environment are illustrated as not being able to select tracks from the screen while walking (division of visual modality), keeping only one piece of earphones in ear while travelling on the bus (division of audio modality), and putting MP3 players in pockets to free hands before shopping (*needs of being hands-free*).

f) The mood of the user

Mobile listening experience is also affected by the *mood of the user* which is said to be the main determinant behind the song selection. It is one of the main themes that refer to the 'user context'. The relationship between the mood of the users and the song selection is exemplified by one participant as *"Sometimes I notice that the music doesn't fit my feelings. It is not good that it takes some time to find nicer music."*

g) Hardware related concerns

In addition to the main themes presented so far, participants also reflected their hardware related concerns. As can be viewed in Figure 5.6, this theme mainly comprises negative experiences with parts and pieces of the mobile listening devices. These negative experiences were illustrated by the some participants as being not able to use the phone with gloves, tangled cables, the annoying process of releasing the cables that have been rolled around the music player. Yet, there were also few positive comments related with how headphones keep ears warm in winter.

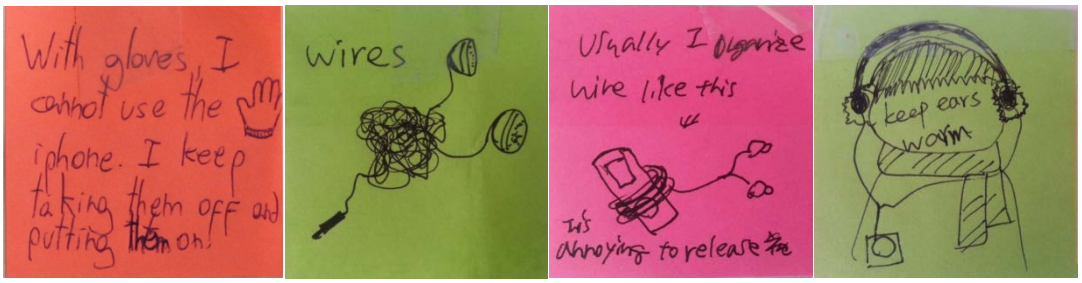


Figure 5.6 Hardware related concerns illustrated by the participants

5.2.3 Discussion

This section offers a discussion on how the concerns of mobile listeners find their place in the user experience frameworks/models that specifically define the role of the context in experience.

All the concerns grouped within the main themes such as mobility, presence of other people, portability can be reclassified under user-product, user-user, and product-product interactions. To illustrate, *accessibility* is a concern related with user-product interactions, since it is meant to be the user's access to the device. The concerns about *portability* can be mainly elaborated under product-product interactions, because users generally utilize other products (bags, jackets, t-shirts) to carry their devices. On the other hand, *presence of other people* corresponds to user-user interactions.

As mentioned in the literature review, each user-product interaction defines it own specific domain of interaction. However, a mere user-product interaction is not enough to discuss user's concerns about mobile listening activity in public environment. The variety of themes derived from the first study requires combining different domains of interactions for the analysis.

Therefore, the contextual diagram of mobile listening interactions presented in this section (Figure 5.7) conceptually appropriates 'Product Ecology' (Forlizzi, 2007), and 'Domain of Interaction' models (Şener & Pedgley, 2014). This way the diagram presents a 'composition' (see the "compositional threads" of user experience in Wright et al., 2007) through the intersections of different domains of interactions in a particular environment.

In Results section (see 5.2.2) it is already given what each theme (presence of people, accessibility, hardware related problems etc.) refers to in detail. However, what this section first will discuss is the reasons behind why each particular theme is associated with particular type(s) of interaction (Table 5.2).

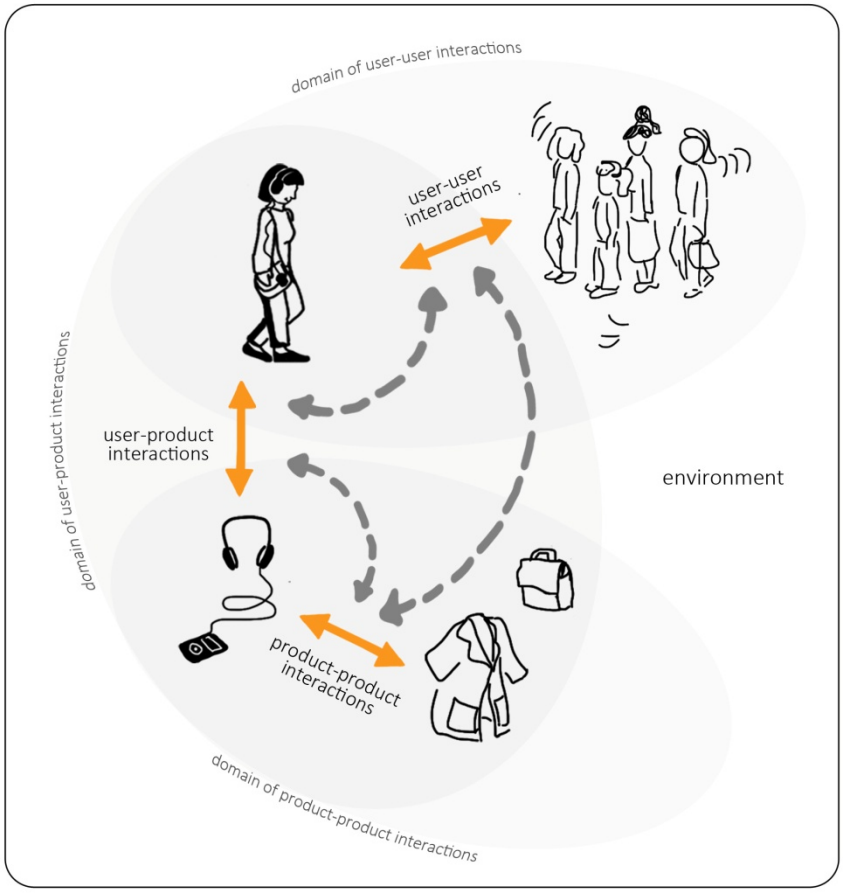
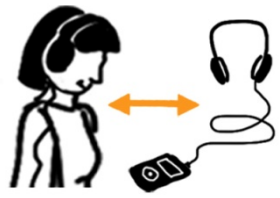


Figure 5.7 Intersection of different domains of interactions regarding mobile listening in public *environment*, illustrated by the author

Table 5.2 Participants' concerns in relation to user-product, product-product and user-user interactions

		
User-product Interactions	**Product-product Interactions**	**User-user (social) interactions**
• accessibility • portability • hardware related concerns • division of attention	• portability • hardware related concerns	• crowdedness • need of isolation • respectful manners • safety of the device and other belongings • division of attention

As can be viewed in Table 5.2, *accessibility, portability, division of attention, hardware related concerns* are listed under *user-product interactions* because they all define how *users* access, carry, pay attention to and deal with the (the problems of) *products*.

Besides, all sub-themes listed under *presence of people* are directly transferred into *user-user interactions*. Aside from these sub-themes, *division of attention* is also added to this category, since other people sharing the public environment with mobile listeners can also be considered as audio-visual stimuli to give attention.

Lastly, *portability, hardware problems,* and *accessibility* are associated with product-product interactions. The reason why *portability* is evaluated under *product-product interaction* is the utilization of other products to carry mobile listening devices. Nevertheless, relations between different listening related products that users deal with also constitute an example for product-product interactions such as headphone-MP3 player interaction. *Hardware related concerns* are also elaborated within this group, since some of the problems in terms of hardware stems from their interaction with other hardware (releasing the wires from the music player) as well as other daily objects (not being able to use touch-screen with gloves) (See Figure 5.7).

The Relationships among Different Type of Interactions

The diagram not only combines different domains of interaction but also shows the relationships among different types of interactions in gray dash-lined arrows as can be seen in Figure 5.8. One example given by a participant explains how user-product, product-product and user-user interactions are interrelated: *"In the bus, I don't want people to know I have an iPod; so I don't want to take it out of my bag even if I want to change the song."*

Here it can be seen how *concerns for the safety of the device and other belongings* increase with the *presence of other people* and how it affects the decision of where to keep the device (*portability*). This clearly illustrates the influence of user-user interactions on product-product interactions. This particular decision regarding the product-product interactions results in not being able to control the product

(regardless if it has the most- 'user friendly' graphical user interface or not); which refers to user-product interactions.

The Level of Representation

There are some elements or aspects of interaction that are not represented in the diagram (Figure 5.7) but should be taken into account in the analysis of mobile listening experience.

In the diagram (Figure 5.7), the products are represented by mobile listening devices and other wearable/portable items by which users mainly carry these devices. Yet, one cannot confine user-product interactions in mobile listening experience to solely user's interactions with mobile listening devices, since the user is simultaneously interacting with other products available in public environment as well. These do not necessarily involve physical engagement of users. What is meant by other products is any element that *divides user's attention* in public context such as automobiles in the traffic or the billboards on the streets. Therefore the term 'environment' in the diagram comprises the other users and products, as well as the place where all these interactions occur (Figure 5.8).

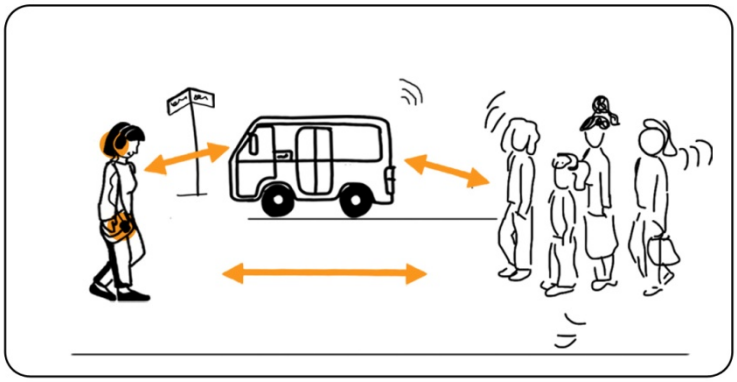


Figure 5.8 Users' interactions with the other products and users in the environment

Another issue to be emphasized within the analysis of the diagram (Figure 5.7) and the table (Table 5.2) is spatio-temporal threads (Wright et al., 2008) of the experience. Although this diagram can be regarded as a 'representation' of the context, the thesis shares the same critical approach with Dourish (2004, p.5) who

implies that context is not the matter of 'representation' of the situation; it is "a relational property between objects or activities". The relativity of the context stems from its spatio-temporal aspects which cannot be represented in this diagram but should be taken into account. For example, mobility is not included in the diagram as a temporal aspect of the experience, yet it should be underlined that it is the mobility that invites other users and products in all these domains of interactions.

5.2.4 The Role of Study 1 in Organizing of Study 2 'Living in the Journey'

Having an idea about the users' concerns about mobile listening experience in public environment contributed to the organization of the second study in which users are expected to test particular products in real context of use. To get as much feedback as possible from the users, the second study included the situations from where all these concerns derived from. Therefore, it is planned in a way that users not just listen to music but perform several activities and tasks within their journey, which require division of Study 2: 'Living in the Journey'.

5.3 Results and Analysis of Study 2 'Living in the Journey'

As articulated in Chapter 4 - Methodology, Study 2 'Living in the Journey' gave participants the chance to reflect on their current experiences by directly using mobile listening devices in the real (defined) context.

The study also aimed to reveal the relationship between varying user interfaces with the real context of use. Therefore, as mentioned in Chapter 4, the products that the participants tested were selected in a way that all of them had different features and their unique ways of interaction. Each of the four music players (i.e. Apple iPod Shuffle 5th generation, Apple iPod Nano 7th generation, Sony NWZ-W273 music player, and Rhythmz Blu HD headphone) were tested by four participants, thus the data utilized in the analysis of Study 2 rests on the reflection of the sixteen participants.

Study 2 was conducted as a *real journey*, in which participants were asked to perform several activities and tasks while travelling with their music players in a particular route (See the map in Figure 4.10 in Chapter 4). These activities and tasks

were pre-determined according to the main themes derived from Study 1 (see Section 5.2.2) to add challenges to their journey. In other words, the activities were arranged in a way that participants would be involved in activities or tasks that require as much social interaction and division of attention as possible. Henceforth, the steps that users went through included using public transportation, buying a chocolate cake form a street buffet, crossing the street by using the overpass, and asking for a specific book at a bookstore. In addition, the author made a phone call to each of the participants in order to ask about what they had done until then. However, the real intention was to interrupt the participants' auditory bubble with the phone call and to cause them to interact with the music player – perhaps in an unplanned way.

The journey ended in a place where the post-interview (Appendix A) with the participants was conducted. The results provided in this section are derived from the responses of the participants in these interviews.

5.3.1 Overview of the Analysis

The analysis process started with the transcription of recorded interviews to Excel spreadsheets on tables that had been organized according to the tasks realized by the participants. This made it easier to see which comment refers to which particular task. There were four spreadsheets for four different music players to better differentiate product/interface-specific responses in the following stages of the analysis.

The transcription was followed by a content analysis in which related keywords were added next to the transcribed responses. Then, these keywords were categorized in relation to user-user, product-product and user-user interactions as in the analysis of Study 1. Following a similar approach with Study 1 enabled a comparative analysis and showed what 'Living in the Journey' study adds to 'Telling about the Journey' study in terms of the depiction of the *contextual* factors in mobile listening experience.

5.3.2 Results

Before going through these concerns by exemplifying how they emerged in the use of every product tested in Study 2, this section will provide a brief overview of the products to make the examples clearer.

- Apple iPod Shuffle (5th generation) is an MP3 player with tiny square aluminium body with a clickable control pad on the front and with a clip on the back. It is selected as a generic example of button-based controls.
- Apple iPod Nano (7th generation) is an MP3 Player, which combines multi touch screen (GUI) and a tangible button for the main controls.
- Sony NWZ-W273 MP3 player is a wearable, wireless MP3 player integrating -music player and earbuds. It is especially selected for its eye-free button-based controls divided into right and left sides.
- Rhythmz Blu HD headphones have distinctive features with a touch sensitive surface for gestural controls. Users can perform main controls (advancing songs and adjusting volume) by swiping the surface horizontally and vertically.
- UrbanEars Plattan headphone is not among the four products tested in Study 2, but it was provided as an alternative to the earphones given with iPods to see how each type of phone influences mobile listening activity.

A more detailed explanation of the product features can be found in Section 4.4.1.1 of the Methodology Chapter.

5.3.2.1 User-User Interactions

Public environment inevitably constitutes a place for social interactions. Some activities performed by the participants in Study 2 made use of such social interactions to see the relationship between mobile listening and presence of other people**.** This section will reflect on mobile listeners' interactions with other people in public environment by adding to the related themes provided in the first study. These interactions will be discussed by referring to all types of products utilized in the journey. The topics that will be covered in this section are i) proximity, ii) appearance, iii) visual detachment, iv) audio detachment, v) alternative ways to communicate, vi) conversations, vii) privacy, and viii) sharing music.

i) Proximity

Crowdedness has already been in the list of concerns related with the social interactions in the results of Study 1. However, the intensity of the crowd has not been discussed earlier in this chapter. Thanks to the different areas in public context such as public transportation, streets and the bookstore included in the journey, it is observed that, rather than the number of people, the proximity matters more for mobile listening experience. According to the participants' responses, *proximity* becomes an issue in terms of:

- ***Whether there is enough space in between people to use controls with hands.*** This is exemplified by the participants by not having enough space to raise hands to perform gestural controls on Rhythmz headphone or by the difficulty to control the iPod Shuffle in the trousers' pocket while sitting next to someone.

- ***Whether the sound that comes from your earphone is heard by others.*** Some participants, especially the users of iPod earphones and Rhythmz headphone stated that they decreased the volume when the minibus got crowded in order to not to disturb other passengers standing right next to them. One participant pointed out a need of a system that indicates how the sound is heard from outside.

- ***Whether the user is close enough to hear another person (or thing) if necessary.*** Some participants illustrated such situation by sitting closer to the driver in minibus in case the driver tells something; or taking headphones (Urbanears) off to be able to hear the buffet staff talking in a particular distance. In the first example, the sonic interchange through volume adjustment is alternated with getting closer to another audio stimulus.

ii) Appearance (of users)

Appearance of users also emerged as a concern regarding the presence of other people in public environment. It refers to both how the mobile listeners look and how

they perform the controls. *How users look with mobile listening devices* depends on different aspects of product features.

- ***Size of the product*** was presented as the main concern behind the preference of earphones over the Urbanears headphone by most of the iPod Shuffle and iPod Nano users. They justified their preference by saying that they did not want to attract attention. One of the biggest complaints about the Rhythmz headphone was also its size which is too big.

- ***Device vs. accessory*** is another category that can be elaborated under how users look with mobile listening devices. There are several responses which illustrate this category. For example, material selection was underlined as one of the factors that make mobile listening devices look like 'a device' or 'an accessory'. Use of textile in Urbanears headphone is appreciated by one participant who stated that *"with textile it feels like an accessory, I don't want to walk with a piece of metal on my head"*. Another participant who tested Sony wearable MP3 player praised its visual harmony with the casual clothes.

- ***The meanings attributed to particular typology of products*** also constitute a concern in terms of appearance. To illustrate, one Rhythmz headphone user stated that the product feels like *"I am good at these things, I am a DJ walking around here"*. Another participant justified not attaching iPod Shuffle to the jacket for it might look like a microphone.

- ***Unprecedented typology of the products*** is another concern in relation to how users look in public environment. Some participants who tested Sony MP3 player stated that they saw many people looking at the product with attention. They accounted this attention of the others for the unconventional form of the MP3 player.

As mentioned earlier, appearance is also related with how people behave; in this case, *how they control the products*. Since the scope of this thesis covers the controls

of mobile listening media, how people are perceived by the others while performing the controls is more relevant than the issue of how people look with these products.

- ***Unprecedented ways of interaction*** was also defined as another factor affecting the way mobile listeners are perceived in public environment. Most of the participants who tested Rhythmz headphone with gestures stated that there has been no corresponding movement to such swiping gestures before; so it attracts attention.

- ***'Weird' associations.*** Above mentioned conditions are not necessarily related with the introduction of a new interaction style. "Controlling the iPod Nano inside of the pocket as if the user is hiding something" or "pushing the pause button of the iPod Shuffle attached to a collar as if the user is pocking himself/herself" can illustrate that how these gestures are considered as weird by the participants.

iii) Visual detachment

Most of the participants mentioned that the earphones or headphones visually communicate the private mode of listening although users do not listen to music at that time. Such concern is applicable for all the products tested within Study 2. Some participants explained one of the reasons behind taking off the headphone/earphone before brief chats (e.g. at a buffet, bookstore etc.) was to eliminate the sign of visual detachment and to show other people that they are actually concentrated on what they are talking even if they can hear the others with the earphones or headphones as well.

iv) Audio detachment

Some participants who tested products with higher level of noise cancellation such as Urbanears headphone and Sony MP3 player with earbuds underlined a*udio detachment* as an issue. Audio detachment is about both not being able to hear others and not being able to hear yourself. The latter corresponds to the isolation from any sound produced by the user. One participant stated that *"For instance, I wanted to ask other people in the overpass to move aside, but I didn't do it. I could not figure*

out if my voice comes out loud; I did not want to shout." Another participant mentioned that *"I hate the condition that my phone rings and everyone in minibus hears it except me."*

One participant constructed an analogy between wearing sun glasses and wearing a headphone while talking to someone, by saying that keeping headphone on your head in a conversation creates the same weird situation when you wear sun glasses and cannot communicate with your eyes. It clearly exemplifies both audio and visual detachment of users.

One participant who used the earphones of iPod Nano even preferred using only one piece of the earphones throughout the journey for not being detached from the environment totally. This way, the participant lessened the number of sonic interchanges and welcomed both sonic worlds at the same time.

v) Alternative ways to communicate: Use of other modalities

Both visual and audio detachment of the users eventually ends up with the use of gestures instead of words to communicate. Some participants illustrated such conditions by being poked by other passengers in the minibus to pass the money on to the driver or being pointed out (by hand) the place of a particular book in bookstore by the staff.

vi) Conversations

In all cases in which participants had to talk to with other people (when they were about to pay in minibus or buffet, ask something in bookstore, or when the author called them), especially when they are faced with a sudden question or comment, most of the participants stated that they responded to such conditions by directly taking off the earphones, headphones, or the device itself (Sony MP3 player). One of the participants named it as a 'reflex', while some participants put it that way: *"Pause? I did not use pause at all. It was my way of pausing [taking it off]."*

vii) Privacy

One participant who tested RHYTHMZ headphones with eyes-free controls stated that being able to control the music without a screen provides more privacy than the smart phones where the user controls the music via the multi touch screen which can be easily viewed by other people.

viii) Sharing music

So far the use of the word "social" stemmed from the share of environment with others. However, the wireless connection between Rhythmz headphone and the phone (product-product interaction) encouraged one participant to take "the social" as sharing music. The participant constructed a scenario where the user can pair his/her Bluetooth-enabled headphones with a music source of another person when the phone is running out of charge.

5.3.2.2 Product-Product Interactions

This section explores the relationship between the mobile listening products and other daily objects or between the different pieces of mobile listening devices. The topics that will be covered are: i) portability decisions, and ii) connection between different means of mobile listening media.

i) Portability decisions

As mobility is enabled with the portability of the music players, the interaction between mobile listening devices and other objects are mainly based on portability.

Looking at how the portable-yet-not-wearable products in the Study 2 such as iPod Shuffle and iPod Nano are carried indicates the possible areas where users wished to perform controls and why. Even though iPod Shuffle was introduced as a wearable product by Apple, the place where it is attached depends on user's decisions; and such flexibility contributed to the Study 2 to see the variety of user preferences.

The main concerns behind the portability decisions can be listed as *safety, accessibility & comfortable use, appearance, prevention of accidental controls,* and

orientation. It is observed that even outside factors like *climate* has an influence on where to carry a mobile listening device.

- ***Safety*** is one of the main criteria for deciding a place or an object to carry a mobile listening device. One participant who used iPod Shuffle mentioned that, while on the minibus the music player was attached to the pocket of the coat, it was removed and attached to the pocket of the trousers (in a more discrete place) after arriving in the city centre, in case someone attempts to take it. The concerns for the safety of the product increase in smaller products, the presence of which is hardly felt while carrying it.

- ***Accessibility of controls and comfort of the use*** is what users want to achieve while deciding how they carry the mobile listening devices. Some participants who used iPod Nano in Study 2 mentioned that even the type of bag affects accessibility and comfort in relation to the length of cable. One participant testing iPod Nano mentioned that she utilized a special pocket in her bag not to search the product every time she wants to control the music. Not only bags but also other wearable items were made use of. To illustrate, another iPod Nano user tucked in the earphone cables inside of the t-shirt to be able to hang earphones when they are not in use.

- ***Appearance,*** as mentioned above with the example of iPod Shuffle and its association with a microphone when it is attached to a collar, is another concern for portability.

- ***Prevention of accidental controls*** is also taken into account while deciding where to carry the product. For example, some participants explained the ways to avoid pressing buttons unintentionally by not putting the iPod Nano next to a telephone or in a small pocket.

- ***Orientation of the product*** was also presented as a concern by one participant who used iPod Shuffle, since the product has a symmetrical layout of

controls. It is stated that, to be able to find the right side of the product on the right, participant attached the iPod Shuffle as its front surface looks towards to the user.

ii) The connection between different means of mobile listening media

According to the participant's responses, connection between different means of mobile listening media mainly refers to the relationship between the earphones/headphones and the media that stores and/or plays music. This connection can be realized with or without cables (through the integration of music player to the earbuds or through wireless data transfer methods like Bluetooth). Cables were largely accounted for limiting the participants' physical movements. Hence, the products with wire-free use such as Sony MP3 player and Rhythmz Bluetooth headphone were all appreciated by their users in the journey.

5.3.2.3 User-Product Interactions

Up until now, the analysis of Study 2 'Living in the Journey' has already touched upon user-product interactions by discussing its relation to user-user and product-product interactions. Yet, this section will focus on the interface-specific concerns of the users.

As mentioned earlier, all four products that were used within the study present diverse forms of interactions. Hence, the concerns related with user-product interactions mainly stem from the particularities of these interfaces. That is why, in this section the titles are organized according to the types of the products.

iPod Shuffle with Button-Based Controls

This section elaborates on the highlighted aspects of iPod Shuffle's product features with a special focus on its button-based controls affecting mobile listening experience in public environment.

- ***Layout of the controls:*** One of the most common complaints about the use of iPod Shuffle was the misleading symmetrical layout of the controls placed on its square body. Since the top/down or right/left sides are not defined clearly

in its design, all participants having used the product stated that they had difficulty in finding the place of a specific button (instead of the play/pause button in the middle) especially when they changed the place they attached the product.

This situation was said to be dealt with by taking the earphone jack as a reference point for the controls. This clearly shows how tactile clues can be useful for better mapping. Most of the participants indeed suggested adding specific textures on the buttons to differentiate between the controls.

- ***Accessibility of the controls and the size of the interaction area:*** One participant mentioned that *"The small size becomes disadvantageous when you have to control the product quickly, larger surfaces can be better."* This response explains that miniaturization of the products for the sake of portability can pose limits in terms of the accessibility of the controls.

- ***Feedback:*** Some participants stated that they found the song playing even if they remembered pressing the pause button. In button-based interfaces without a screen, it is difficult to visually communicate if the controls of the user are processed or not. iPod Shuffle does not provide any audio or visual feedback for the main controls (i.e play/pause, volume up/down, skip back/forward) in addition to the changes in the music itself.

iPod Nano with GUI on Multi-Touch Screen and a Physical Button for the Main controls

The use of iPod Nano was significant to explore the role of a screen while interacting with the songs. Combination of graphical user interface (GUI) and a physical button enables the discussion of their advantages and disadvantages over each other by looking at which one was prioritised at which circumstance. Therefore, this section elaborates on the user-product relationships through the participants' concerns related with the use of GUIs and button-based controls. The discussion will be presented

under i) interacting with a multi-touch screen with graphical user interface, ii) multi-functional tangible button, and iii) transition between the interfaces

i) Interacting with a multi-touch screen with graphical user interface

- ***Controls through GUI on the screen:*** According to the participants, multi-touch screen of iPod Nano was mainly used for song selection. One participant claimed that sliding the menus and playlists with one hand made the song selection easier. Yet, all participants who dealt with the GUI of iPod Nano were in consensus that the horizontal bar for the sound control communicated itself wrong; the bar rather seemed like the time bar.

- ***Mobility vs. controls on the screen:*** The participants (except the ones who already used shuffle function) stated that they did not select a specific song from the GUI menu while walking; for this they would have to decrease their walking speed or stop. Instead they used skipping back and forward to change the song because they were able to perform it through the tangible button on the side.

- ***Information on the screen:*** The other feature enhancing the interaction with the multi touch screen was presented as being able to reach all necessary track info at once. According to one participant, inclusion of album cover photos eliminated the need of reading the name of the tracks/albums/artists all the time. Another participant mentioned that, it is a really nice feature that one does not have to check the time from his/her phone thanks to the digital clock on the screen.

ii) Multi-functional tangible button

Except for the song selection, all participants stated that they utilized either the tangible button on the iPod (the ones who used the Apple earpods) or the remote on the Urbanears headphone for the main controls. Even though it was preferred over the touch controls on the screen there were also problems regarding the use of the button.

Most of the participants said that they unintentionally stopped the music while they were trying to volume up through the button. Performing different controls by pressing the three different sides (top, middle, down) of the one singular surface of the button causes such accidental controls. The formal and tactile properties of the button fell short of communicating the different functions of different areas especially when the participants wished to deal with it without looking at the product.

Even though placing the button on the side, rather than on the front surface, was appreciated by a participant in terms of preventing accidental controls, from other comments, it is seen that the tiny button 'sliced' from the product's thin side surface creates difficulties in interaction. A participant stated that *"It does not feel like a button, it is in between a surface and a button."* This can be presented as a dilemma between the being a tiny, portable MP3 player and having clear physical affordances to be pressed by a finger.

iii) Transition Between the Interfaces

The results show that these different types of interfaces can be used alternately in different conditions because of different accessibility options. One participant who used Urbanears headphone with a remote said that:

> *When I was standing in minibus, I always used the remote to skip the songs. When I started to sit, I took it out of my bag to select songs from the menu. Since I was holding it with my hand, I used the tangible button on the side to skip songs; I did not want to raise my hand up to the remote.*

Sony NWZ-W273 Wearable MP3 Player with Eyes-Free Button-Based Controls

The analysis of user-product interactions offered by this Sony MP3 Player mainly follows its highlighting features such as i) wearability and its ii) eyes-free button-based controls. These features will be examined both in terms of functional and aesthetic aspects of the interaction

i) Wearability

Wearability and the cable-free use enabled by the wearability of the product were all appreciated by the users with regards to *freedom of movement.* One participant exemplifies this by saying that *"I always have a bag or coat at my hands while travelling. Without cables it was pretty easier to sit down and stand up with my belongings in minibus. It also enabled me to easily turn my head towards right and left"*. The only negative comment regarding the wearability was *the difficulty of putting on and taking off* the MP3 player especially with loose long hair.

ii) Eyes-free button-based Controls

Being not able to see the controls was defined as having less control over the product by some participants. One participant criticized the product by claiming that *"As if they directly transferred two generic MP3 players to the ears. There is nothing that helps me to perform the eyes-free controls."* Therefore, it can be argued that, this low level of autonomy does not only stem from eyes-free controls but also the way the button-based controls are designed.

- ***Getting used to the controls:*** One of the main problems regarding the button-based controls can be associated with the division of buttons to the right and left side of the product. All participants mentioned that it took a long time to get used to the places of controls.

- ***Layout/ Mapping of the controls:*** The product has a similar mapping on both sides: one tiny circular button for the pause/play (on the right) or shuffle/playlist mode (on the left); one tiny rectangular button with two ends for the binary controls of skip back/forward (on the right) and volume up/down (on the left). According to all participants, such mapping helps differentiating the functions on one side but it is not adequate to differentiate one side from the other.

  One participant raised another criticism to the mapping of the controls by saying that *"It feels wrong to volume 'up/down' by pressing the 'front/back'*

side of the button." It shows that although the product tries to build a common language in both sides of the product; it may not match with the nature of the controls.

- ***'Feel' of Controls*** Feel of controls can be treated both in terms of functional and aesthetics aspects of the controls.

  Regarding the aesthetics of the button-based controls, one participant stated that *"I don't like that it hurt my fingers, it would be better to press more smooth and circular buttons".* Another participant added that *"It could have been designed in a way that they feel good, by not making me pressing that hard."* They both provided options for better tactile experience.

  Regarding the functional controls, all participants criticized the size of the buttons and demanded for larger space to perform controls by pointing out the side surfaces as an alternative interaction area of the product. The small size and rigidity of the buttons were also accounted for not being able to feel if the button is pressed or not. Some participants stated that, compared to the buttons, even the lock slide gives more feedback about the product; since one can feel the last condition of the slide by directly feeling where the slot is.

- ***'Hear' of controls:*** In this section the audio feedbacks will also be evaluated in terms of their functional and aesthetic aspects. One participant stated that *"It is useful that it says 'shuffle on/off'; otherwise, I couldn't have understood if I pressed the button or not, since it was the first time that I listened to these songs."*

  Another comment made by another participant was more related with the aesthetics of the audio feedback that the tone of the woman speaking was not robotic; it was more natural comparing to the other applications with audio feedback.

Rhythmz Blu HD Headphones with Eyes-Free Touch Gesture Controls

The evaluation of the user-product interactions offered by Rhythmz Blu HD headphone is significant to see the strengths and weaknesses of performing gestural controls while listening on-the-go in public environment.

i) Different dimensions of a gesture

The concerns related with gestural interfaces as physical movements are strongly related with different parameters of a physical movement such as speed, pressure and the space defined by the movement.

Pressure applied for the Touch 'sensitive' surface: Most of the participants complained about the sensitivity of the headphone, since it does not function well unless the user swipes the surface horizontally or vertically with a particular pressure. One participant alternated the swiping gesture by using the thumb instead of the forefinger to reach the necessary pressure and to swipe as much as surface to perform the function without a problem.

Definition of the interaction area: The gestures in this product should be applied in a way that they follow an invisible line on the headphone surface. Referring to the responses of all participants who tried the product, it can be argued that such invisibility of the interaction area sometimes ended up with not controlling the device. All participants said that they had to repeat the same gesture three or four times. Therefore, they demanded a textural or material change on the surface to guide users from the start and end point of the swiping surface.

Touch sensitive surface on the right. The gestural controls can only be performed on the right sight of the product. This was criticized by all the participants. Some participants claimed that, depending on the context such as holding bags with one hand or holding the seat in the minibus while standing they may want to change the place of interaction. Some participants also questioned that there is nothing which communicates the 'functional' side of the product and demanded for a textural

difference between the two sides of the headphone. Such condition became more problematic for one left-handed participant who had to wear the headphone reverse.

Reliance on the physical: The above part mentioned the trial and error process that participants went through. Yet, these repetitive actions are not only caused by problems related with the sensitivity of the headphone surface. They are also related with the controls themselves. Unlike the sound bars in GUIs, in this product one swipe for volume up/ down means an increase or decrease of the volume in a limited range. For example to reach the highest volume from mute, the user has to swipe the surface for several times.

Users' subjective interpretations: One participant stated that the controls relied on these repetitive hand gestures can be very overwhelming. To deal with this situation, the participant came up with an interesting interpretation of controls:

> *"I was a bit bored of doing this. When I was walking in Karanfil Street and looking at shop windows, I kept my finger stable and somehow make it swipe the headphone's surface by turning my head towards right and left."*

Fun: Most of the participants stated that they really enjoyed doing these "continuous" swiping gestures as long as the surface sensed them. They stated that it would be more seamless if they don't have to swipe all the surface with pressure and to be able to control with a little touch towards right, left, up or down as in multi-touch surfaces of smart phones.

ii) Problems with multi-functional button

The product has one little button for on/off, pairing the device and play/pause with different durations of pressing. All participants agreed that the button created reluctance to press, since they were afraid to cut Bluetooth connection, while they were just trying to pause the song and they added that it would be better to pause again with a gesture instead of finding the place of the button.

This shows that a gesture can be more preferable over a button to switch between private-mode of listening to public-mode seamlessly, depending on how it is applied in the product.

5.3.3 Discussion

This section discusses the results in terms of their applicability to the scope of this thesis, which is the exploration of the potentials of embodied elements and actions for the aesthetics of interaction of mobile listening media.

5.3.3.1 The Relationship among User-User, Product-Product and User-User interactions

Study 2 'Living in the Journey' shows how user-user, product-product and user-user interactions are interrelated with each other and in this sense confirms the results of Study 1. Seeing the way the proximity (the distance between users) affects the 3d space in which the product controls are performed or the place where the product is carried can exemplify the influence of user-user interactions on user-product and product-product interactions. Common concerns in different domains of interactions such as safety or appearance, or being able to talk about different type of interfaces under these domains also underline this relationship.

5.3.3.2 Embodiment

The examples given by the participants who took the 'journey' are significant in terms of exploring the embodied actions and objects in mobile listening experience. For example, portability of mobile listening devices gives clues about how daily objects have already been utilized to enhance the user's interactions with mobile listening media.

This section will now provide a brief comparative analysis of different types of interfaces especially in terms of embodiment. In this study, it is observed that the participants prefer using button-based controls without dealing with GUI on the screen while listening to music on-the-go. It should also be mentioned that such preference is mainly applicable to the *main controls* (play/pause, volume up/down, which are less complex compared to other listening related controls such as song or

playlist selection that requires more time and (visual) attention. The research indeed focuses on the main controls that are essential to deal with mobile listening media while on-the-go; yet it also welcomes the insights that can inspire the interaction designs of other controls.

Another insight derived from the analysis of Study 2 is that, interacting with the buttons becomes more challenging as the MP3 players are scaled down for the sake of portability/wearability. The decrease in the size of the product also decreases the size of interaction area; confining the controls into finding and pressing these tiny buttons, which makes users' switch from private mode of listening to music to the public mode harder.

It can be seen that, with the transition of mobile listening media from tiny separate *devices* (represented with iPod Nano) to more wearable *accessories* (Sony MP3 players) the concerns such as safety, accessibility and freedom of movement diminished; since they become more *embodied* with the users' body and activities. Furthermore, it is observed that the 'fun' aspect of products (Saffer, 2008) and the level of user's "subjective interpretations" (Ferneaus, 2008) increased as the controls become more 'tangible' with touch-gestures according to the users' comments about Rhythmz Blu HD headphone.

This analysis is also inspiring for the aesthetics of interactions in the sense that users try to make use of different sensory modalities in their mobile listening activities as much as possible. Other people using gestures instead of speaking not to divide mobile listener's audio modality into two tasks (as in minibus and bookstore examples), or users' demands for tactile affordances or audio feedbacks illustrate how multi-modality can enhance mobile listening interactions. In this regard, taking earphones or headphones off before conversations as a "reflex" (that is what a participant calls it) is also worth exploring as an "embodied *action"* (Dourish, 2004). Such embodied action or 'reflex' is already utilized for designing more intuitive interactions in Parot Zik heaphones (2014) by which users can pause the music by taking off (see Section 3.9.4 of Chapter 3).

5.3.3.3 The Role of Study 2 in Organizing Study 3 'Dreaming about the Journey'

The journey that the participants went through within 'Living in the Journey' constitutes an underlying experience for Study 3 in which the four of these participants are expected to dream about new types of controls for mobile listening media through the use of daily objects and gestures.

The analysis of Study 2 provides a 'list of concerns' that can be taken into account in the analysis of users' responses (performances) in Study 3 in terms of their applicability to the context. Hence, the discussion of Study 2 will eventually continue under the discussion of Study 3.

5.4 Results and Analysis of Study 3 'Dreaming about the Journey'

Within the third study 'Dreaming about the Journey' participants were expected to explore the ways of utilizing embodied elements of mobile listening activity in public environment as means of controlling music in one-hour generative session.

As mentioned in Methodology Chapter, this generative session includes four stages: i) overview of non-instrumental interactions and alternative ways of controlling available devices, ii) utilization of daily objects, iii) utilization of bodily gestures; and iv) controls beyond the limits of the technology.

The first stage, i) *overview of non-instrumental interactions and alternative ways of controlling available devices*, aimed to reveal the hidden potentials of available mobile listening devices to provide richer tangible interactions that go beyond their interfaces. Therefore, in this stage users were expected to question whether their non-instrumental interactions with the available mobile listening devices could transform into or be part of the interface of mobile listening media.

The following stage, ii) *utilization of daily objects*, tried to explore the relationship between listening related controls and tangibility. Hence, it focused on other daily products (besides mobile listening devices) that *already* accompany the users while travelling with music and encouraged users to dream about making use of the tangible properties of these products to control music.

The third stage, iii) *utilization of bodily gestures*, aimed to understand the potentials of another mean of embodied interactions: bodily movements. Here participants were expected to 'perform' listening related controls through bodily movements/gestures.

Finally, in *iv) controls beyond the limits of the technology* the participants were encouraged to think beyond the limits of the technology to explore the potentials of the context as much as possible, especially in terms of exploitation of different sensory modalities. Although they are presented as four different stages, they are highly intertwined to each other. For instance; the physical manipulations of daily objects may require particular bodily movements like in the example of shaking the device for shuffling songs. Conversely, daily objects can be utilized as controllers of gestural user interfaces. Henceforth, the main categories derived from the user's actions/responses in this generative session refer to more than one stage. However, to make it clear, the findings of this phase are given by following the order of these stages as much as possible.

5.4.1 Overview of the Analysis

Before sharing the results of the phase, this section will briefly mention about how the qualitative data derived from this study have been analysed.

The generative session was recorded with a video camera and most of the performed responses of the participants were photographed. The initial analysis included the categorization of the photographs within emerging themes. The themes were formed by the way people interact with or interpret available mobile listening devices, the way they utilize daily objects which are used in listening on-the-go or accompanying activities, and the way they define particular bodily movements/gestures as controls.

The recordings helped to complete the missing visuals with video screenshots and to note down the examples which were not performed but only spoken. The participants' justifications of the controls were also added under the related categories. With further classification of the responses according to different types of controls, the analysis process was completed.

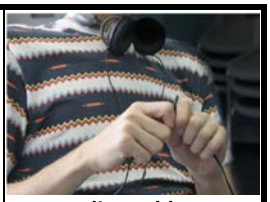
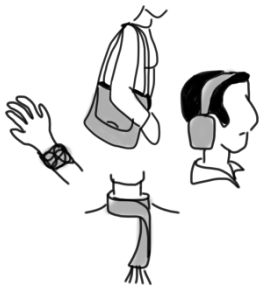
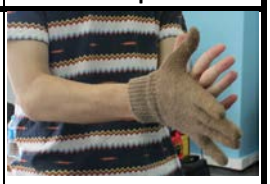
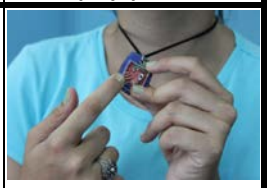
5.4.2 Results

Results of the third study will be presented under categories derived from the generative session. First category, *i) non-instrumental interactions and alternative ways of controlling available devices,* involves the results of the first stage. After dealing with the use of available mobile listening devices, within second category, *ii) utilization of daily object*s, the focus will be directed to the other objects and their possible utilization in conceptualization of new aesthetic interactions. Third category, *iii) utilization of bodily movements/gestures,* comprises the exploration of bodily movements to perform listening related controls. Final category, *iv) exploration of different sensorial interactions,* is mainly derived from the last stage where users were encouraged to think beyond the limits of technology. This resulted in further exploration of a various sensory modalities to be exploited for the controls; that is why it is called as 'exploration of different sensorial interactions'. These categories and sub-categories (if applicable) can be viewed in Table 5.3 with related images of uses' responses.

5.4.2.1 Overview of Non-Instrumental Interactions and Alternative Ways of Controlling Available Devices

This section presents the results of the first stage of the generative session which enabled participants to reflect on their previous and current experiences rather than directly searching for alternative controls of mobile listening. The warm-up presentation summarizing the second study 'Living in the Journey' constituted a reference for all participants to get inspired from what they had already been doing while listening on the go. The results mainly derived from this stage can be categorized as *a)controls inspired from non-instrumental interactions* and *b)controls performed beyond the designed interface of available mobile listening products* (Table 5.3).

Table 5.3 Main categories derived from different stages of the generative session

 **i) non-instrumental interactions and alternative ways of controlling available devices**	**a) controls inspired from non-instrumental interactions*** **interactions which do not own a functional purpose such as "playing with or caressing the product" (Desmet & Hekkert, 2007, p.58).*	 **Bending cables to volume down**
	b) controls performed beyond the designed interface of available mobile listening products	 **Reversing the player to pause**
 **ii) utilization of daily objects**	**a) depiction of potential areas to attach controls**	 **Controls on the backpack handle**
	b) utilization of the objects already involved in accompanying activities	 **Pausing the song when the wallet is open**
	c) re-conceptualisation of daily objects as means of controls	 **Pulling the right end of scarf to skip forward**
 **iii) utilization of bodily movements/gestures**	*main and additional controls performed with gestures*	 **Clapping the hands to play/pause**
iv) exploration of different sensorial interactions	*taste, tactility, sound*	 **Touching the rough texture to shuffle**

5.4.2.1.1 Controls Inspired from Non-Instrumental Interactions

The examples given for non-instrumental interactions by participants include playing with earphone cables, making sounds by swiping the textured surface of headphones and, tapping to the surface of music players or headphones with the rhythm of the song. These examples show that although they don't have any functional purpose, this type of interactions also interprets the physical affordances and exploits the material properties of the products like in the example of the exploration of the cable's deformability.

In this session, some of these examples were reconsidered as possible listening controls. One participant constructed an analogy between running water in a pipe and the sound as if it literally travels through the cable into our ear, and attributed a 'volume down' function to bending the cable. The idea was furthered that multiple bending can decrease the sound more (Figure 5.9, on the left). Another example which exploits the deformability of the cable was shuffling songs through rolling the cable (Figure 5.9, on the right)

Figure 5.9 Bending the cables to decrease the volume, rolling the cables to shuffle

It was discussed that bending or rolling the cable with two hands could be challenging especially while standing in minibus, bus or metro. Participants also considered alternative controls in which one end of the cable is attached on the clothing to free one of the hands.

The tapping on headphone's surface directly affects the way you hear the sound. Although it is defined as non-instrumental interactions, it eventually turns into a way to control the sound by increasing the beat. Although it is not within the scope of this

research, it should be mentioned that these physical actions carry potentials for such kind of sound manipulations in digital systems as well.

5.4.2.1.2 Controls Performed beyond the Designed Interface of Available Mobile Listening Products

Discussion on previous experiences encouraged the participants to further exploit the potentials of available mobile listening devices. The alternatives proposed by participants can be grouped into two:

1) Particular actions which have already been used as controls instead of the controls offered by the interfaces of available products
2) Alternative controls provided in this generative session through the exploration of mobile listening products

The first group reveals the hidden functions behind the actions performed with mobile listening devices. They can be exemplified with the situations where users take off the headphones to give a pause to the listening activity when they have to involve in a conversation or want to direct their attention to something else than music. In 'Living in the Journey' study it was already mentioned that, especially in social interactions, the reason behind this gesture is to give the message that 'I am fully concentrated on our conversation' to the others as a respectful manner. Therefore, in this session, it was offered that taking off headphones can be used as an automatic pause in such cases, which would neither ruin the best part of the songs, nor the conversation.

Figure 5.10 Pausing the song by taking the headphone off

On the other hand, the second group is more related with the attribution of particular functions to the alternative physical manipulations of available mobile listening devices. To illustrate, turning the back of the music player was defined as a device-based gesture to pause the music as shown in the Figure 5.11. It was stated that the table used in this gesture can be alternated with user's body considering the mobility.

Figure 5.11 Pausing the song by reversing the music player

Concerning all possible places where the music players are carried, it was also proposed that the place where users put the device can determine the playlist (Figure 5.12). This example is worth highlighting because it eventually provides a solution to the difficulties experienced in button-based or eyes-free interfaces while searching for a specific album or playlist, because they require constant advancing of playlists until finding the desired one. In Study 2, it was presented as one of the biggest disadvantages of eyes-free controls compared to graphical user interfaces, in which the place of the album/playlist is already determined in a graphical layout, mostly in an alphabetical order. Therefore what this example does is enhancing eyes-free controls by creating a physical layout for the placement of playlists through the daily objects which we use to carry our portable music players.

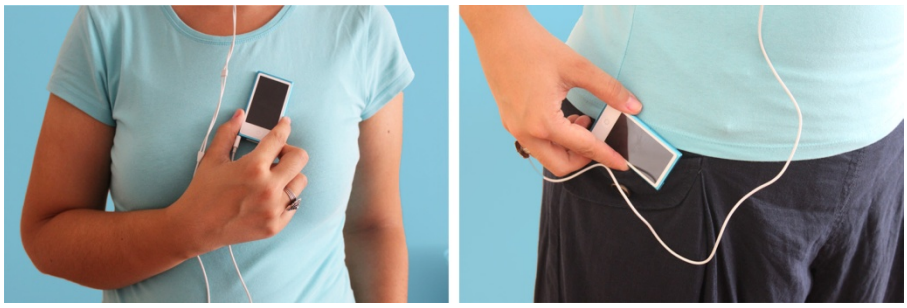


Figure 5.12 Changing the place of the device to change the playlist

5.4.2.2 Utilization of Daily Objects

The previous examples were more related with users' interactions with the available mobile listening devices. Nevertheless, in the second stage, the participants were asked to focus on the objects which are not as direct participants of mobile listening activity as music players; but somehow join the journey of the users. The way the participants utilized these daily objects can be classified as a*) depiction of potential areas to attach controls, b) utilization of objects already involved in accompanying activities, and c) re-conceptualisation of daily objects as means of controls* (Table 5.3).

5.4.2.2.1 Depiction of Potential Areas to Attach Controls

This category differs from other categories derived from the second stage; because, it focuses on how participants made use of the daily objects solely to attach the existing controls rather than redefining the way of performing these controls by physically manipulating the objects.

Figure 5.13 Depiction of potential areas to attach the main controls

The responses of participants mainly reflect the need of accessibility of controls. While some participants utilized the parts where they hold their bags in which music players are carried; others mentioned that the side of our legs, as the closest place to

our hands, could be the ideal place to perform controls (Figure 5.13). Another example derived from the formal characteristics of the object as well as its accessibility can be seen in Figure 5.13 in which the user attributed different functions/controls to the each piece of the bracelet.

5.4.2.2.2 Utilization of the Objects Already Involved in Accompanying Activities

This category deals with physical manipulations of daily objects which are somehow embodied in the activities which mobile listening goes along with. The first and second studies of the fieldwork have already showed that the activities in public environment such as travelling in public transportation, shopping and so on affect the way we interact with mobile listening devices. Therefore, the examples grouped under this category helps us to question if the way users interact with the objects used in/for these activities could directly transform into the controls of mobile listening devices.

Figure 5.14 Pausing the song by opening the wallet in purchase (on the left); switching the music on by fastening the clip buckles of a backpack at the beginning of the journey (on the right).

One of the examples was based on purchasing something while listening to music: One participant stated that giving and taking money requires attention and it might be useful to pause the music directly by opening the wallet (Figure 5.14).

Another example was based on the use of bags. Bags are the objects that users carry in public spaces to access their personal belongings; so they have something in common with personal music players in which users store their personal music archive to be enjoyed in the public space. The active use of both bags and music players somehow defines the time users spend in public environment. Some of the

examples provided by users in this stage made use of this similarity and simultaneous use of bags and music players. These examples includes adding a pause function to leaving the bags onto a chair after coming home as well as turning on the music by using the clip buckles of a backpack when the journey is about to start (Figure 5.14).

Participants also stated that these examples are better conceived as additional ways of controls to be utilized in particular activities with particular objects. In other words, referring to the 'wallet' example, users don't have to open their wallet each time they want to pause the song; however they can use this when they are about to pay money with more concentration. Therefore such approaches in interaction should be customized according to the sensitivity of users, their daily rituals and so on.

5.4.2.2.3 Re-conceptualization of Daily Objects as Means of Controls

There are a wide range of examples to discuss under this category thanks to the variety of objects provided in the venue and brought by the participants. However instead of discussing all the products re-conceptualized in this generative session one by one, the responses of users will be organized according to the different types of controls.

The overview of the responses starts with the main controls defined as play/pause; volume up/down and skip back/forward (advancing songs). However the users were also welcome to explore the alternatives for other controls such as shuffle and playlist selection in case they feel that a particular product 'irresistibly' affords to perform a specific control.

Play and/or Pause

After scanning the physical changes which were applied to the daily objects to perform play and /or pause, it can be claimed that play/pause function was generally realized with sudden, sharp movements which do not include any repetition or acceleration inside (See Figures 5.15 and 5.16).

Figure 5.15 Pausing and playing the song by a tap on the flat necklace, a tap on the skirt, touching on the front flat surface of the brooch

Figure 5.16 Pausing and playing the song by pulling the stripe of an umbrella, stretching the elastic bracelet and leaving it back, turning the elastic bracelets inwards

Skip Back and Forward

The contrast between the back and the forward was reflected in physical manipulations of daily objects through the binary of right and left (when pulling or tilting something) (Figure 5.17), or clockwise and counterclockwise (when turning something) (Figure 5.18).

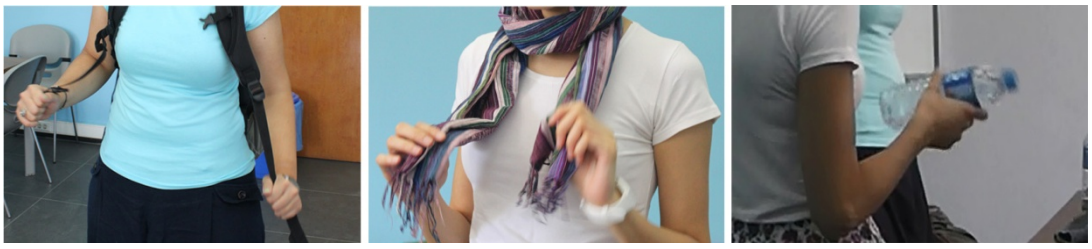


Figure 5.17 Skipping to the next or previous song by pulling the fasteners on the right or left side, pulling right or left end of the scarf down and tilting the water bottle towards left and right

Figure 5.18 Skipping to the next or previous song by turning the hat, turning the circular piece on the ring and turning the brooch in clockwise or counterclockwise.

Volume Up and Down

Similar to the skipping back/forward; volume up/down function was realized through turning things or pulling things up and down. The highest and lowest volume of the sound defines a scale and these movements (pulling sth up/down or turning sth clockwise or counterclockwise) tries to scan a particular range of volume within this scale (Figures 5.19 and 5.20).

Figure 5.19 Increasing or decreasing the volume by sliding the zip or swiping fingers through the edge of the skirt's pocket

Figure 5.20 Increasing or decreasing the volume by turning the umbrella clockwise or counterclockwise; or swiping the circular frame of the watch

Song/Track selection

The objects kept inspiring the participants for other controls as well. As can be seen in Figure 5.21 one participant utilized a key chain with a tape measure for both selection of songs and playing the songs. According to this interaction scenario; first the song to be played is determined by until which number the tape is pulled, then the song starts playing with the release of the tape.

Figure 5.21 Selecting and playing the song by pulling and releasing the tape

Shuffle

Shuffling the songs refers to the change in the order of the songs. The participants chose different ways to perform shuffling songs from shaking the water bottles to creasing the skirt (Figure 5.22); altering the existing physical structure (order) of the objects.

Figure 5.22 Shuffling the songs by shaking the bottle and creasing the skirt

5.4.2.3 Utilization of Bodily Movements/Gestures

The alternatives provided for listening-related controls so far are based on physical manipulations of either the available mobile listening devices or daily objects that we keep dealing with while listening on-the-go. This section, on the other hand will discuss the gestural ways to perform these controls.

The examples to be presented under this category mainly include gestures performed with different objects. However it is essential to mention that the main role of the objects in gestural interactions was to track the bodily movements of users rather than to involve in the interaction through the physical changes they go through. Therefore in gestural controls the formal and material qualities of the objects are not as influential as in tangible interactions which are illustrated in previous section. Due

to this loose relationship between the objects and gestures, there are plenty of examples that utilized the same object for completely different gestural controls, as can be seen in Figures 5.23 and 5.24.

Play and/or Pause

The hand gestures defining the controls 'play and pause' use wearable accessories like gloves and bracelets to sense the movements of the user. Similar to the play-pause alternatives provided in the second stage; play/pause gestures are also fast and sharp in character (Figure 5.23).

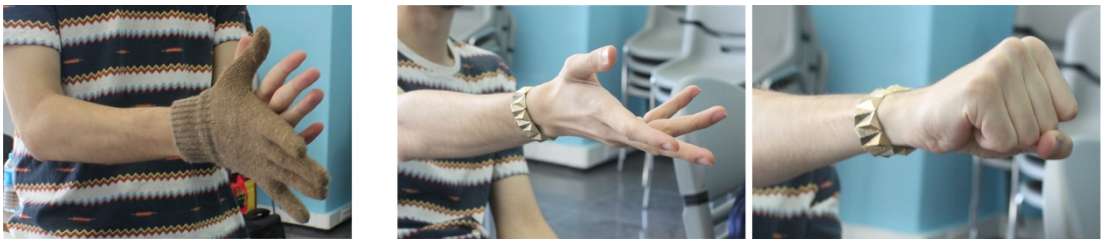


Figure 5.23 Playing and pausing songs: Gloves sensing the clapping of the hands; the bracelet sensing the muscular movements specific to the each hand gesture which corresponds to play and pause in order, from left to right

Volume Up/Down

The objects used in the example for play/pause function were also used to perform volume up/down. While one gesture constitutes an invisible sound bar between two hands; the other example tries to point up/down by the use of thumb; which actually has different connotations as 'like' and 'dislike' (Figure 5.25).

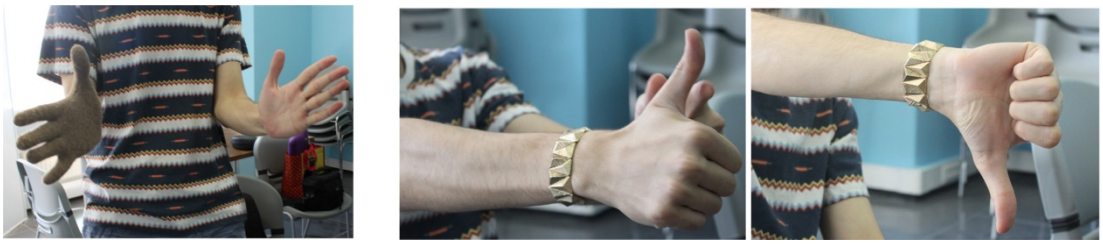


Figure 5.24 Increasing or decreasing the volume according to the distance between the two hands; thumps up/down to volume up/down

Skip Forward and Back (Advancing the songs)

Skipping from one song to another was performed with a sliding motion of the hand.

Figure 5.25 Advancing songs with sliding motion of the hand.

All controls

There are some examples presented by participants which do not exactly define how specific types of controls are realized, but underlines the potentials of using particular objects or parts of body for controlling music.

As can be seen in Figure 5.26 one of the participants attached a clip to his shorts to activate and enable the interactive system to sense the foot gestures. The participant mentioned that one can attribute different functions to the movements of the feet such as stomping once to play pause, swiping the feet on the floor to adjust the volume or change the song.

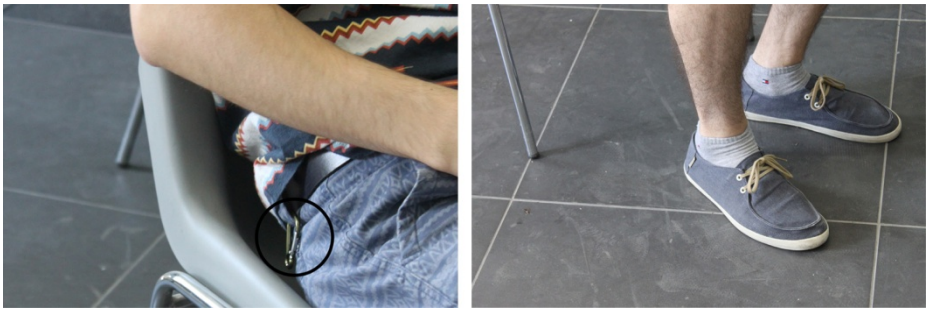


Figure 5.26 Foot gestures tracked by the clip attached to the short

These foot gestures are more applicable when users are temporally sitting in public transportation rather than the times when they are actively mobile. However, according to the participant's user scenario the body parts to perform gestures can be customized with the help of little clip (Figure 5.26, on the left) which activates the interactive system.

Another gestural control performed in this session makes use of the jewellery. In this example, the participant offered that the gestural controls can be defined through the spatial relations between different pieces of jewellery. The position or motion of the hand with the ring can be detected by the earrings and transformed into the listening related controls (Figure 5.27).

Figure 5.27 Controls through the proximity of different pieces of jewellery

Although the main focus is the 'control of digital data' through the objects and gestures; there are also some representational relationships constructed between music and the objects which are somehow utilized in gestural or tangible interactions: The idea of using different pieces in a set of jewellery as controllers in gestural interactions was furthered by the idea of jewellery sets with a playlist of specific genre. It was also proposed that particular materials can be matched with particular genre in music; such as pearl for classical music, iron for metal music etc.

Shuffle

Hair as one of the most deformable parts of our body inspired the gestural control of shuffle as can be seen in Figure 5.28.

Figure 5.28 Shuffling songs by playing with the hair

Like

Another additional control performed by a gesture was to 'like' ( ) a song. With the introduction of digital social platforms; 'like' has transformed into a control to enable users to show their appreciation. In Figure 5.29 the participant likes a song by the gesture of placing one hand on heart. In a scenario where the music player is directly connected to one of these social platforms or online radios; this gesture can enable users to like a song and even to improve the playlist of an online radio according to their preferences as in applications like "Spotify".

Figure 5.29 'Liking' the song by placing one hand on heart.

Track selection according to the pace

Use of bodily movements inevitably brings sports to the mind. One participant stated that it would be great if the songs with particular rhythms were automatically offered according to the pace of run. Even though such control is associated with another specific mode of listening, it can be applied to the public environment as well depending on being on rush or in a more relaxed mode.

5.4.2.4 Exploration of Different Sensorial Interactions

The examples presented in all stages exploit few specific sensory modalities. The sensorial inputs in these controls mainly involve visual tactile and kinesthetic ones. Especially in the last stage of the session in which users are encouraged to think beyond the capabilities of current technologies; some other sensory modalities were also included in the interaction.

Taste

One participant illustrated a scenario in which the albums of artists are sold in the form a package of biscuits each of which has different form and taste referring to the songs. The song starts to play when the taste receptors sense the specific type of biscuit. Similar to the material-genre relationship in the jewellery example; in this example representational relationship is constructed between the taste and specific songs. Another participant associated other physical characteristics of food and drink with music by giving the example that sparkling water can represent progressive songs.

Sound

The sound is always with users while listening. However, when it comes to use the sound as an input in controlling music, the responses given by the participants included voice commands (telling what to do the device) and commands in the form of whistles.

Tactility

A tactile interaction is inevitable when users hold or make physical alterations on physical objects; however there is one example which exploited the textural properties of a product more. As can be seen in Figure 5.30, the participant touches the roughest part of the necklace to activate the shuffle mode.

Figure 5.30 Shuffling the songs by touching the roughest surface of the necklace

5.4.3 Discussion

The titles in this discussion were determined in a way that the potentials of these examples can be discussed in relation to the contextual factors as well as their aesthetics of interactions. First, under the title of *'Practical concerns: The applicable controls for mobile listening in public environment'*, how these new types of controls find their place within the context of use will be elaborated. Second, under the title of *'The Relationship between the nature of controls and the physical manipulations'* the discussion will go deeper into the user-product interactions by looking at the ways the participants constructed new links between physicality and the controls.

This generative session also presented new possibilities in terms of representation of music itself, which also affects the users' way of controlling it, like in the example of listening to a song by eating (control) a biscuit (representation). Hence, lastly, this new discussion point will be elaborated under the title of *'Beyond the Controls: Representational Relationships'* in Section 5.4.3.3.

5.4.3.1 Practical Concerns: The Applicable Controls for Mobile Listening in Public Environment

The practical concerns will be presented in the same order with the two main stages that participants have gone through in the generative session; namely, tangible controls and gestural controls. The issues articulated under each type of controls differ from each other because of the particularities of these controls such as presence or non-presence of physical affordances. However, they will be both evaluated in terms of their constraints and possibilities with reference to the users' concerns about public context of use; as well as their technological applicability.

5.4.3.1.1. Tangible Controls

The interactions elaborated within this section both refer to tangible user interactions and organic user interfaces considering the flexibility of the physical manipulations applied to the objects. The issues which will be elaborated under 'Tangible Controls' include *the reinterpretation of (perceived) physical affordances, activity-control relationships, technological applicability and how to interpret the selection of objects for the controls.*

The Reinterpretation of (Perceived) Physical Affordances

In all examples that have been touched upon earlier within results of the 'Dreaming about the Journey' study, the physical affordances of objects and the way they are used have mainly remained the same. However, what participants have done is the reinterpretation of these affordances and attribution of new meanings to these objects within mobile listening in public environment. The examples are quite inspirational for the conceptualization of new aesthetic interactions. Yet, in terms of reinterpretation of the affordances, the following part will deal with two main concerns:

1) The difficulty of differentiation between the function of the objects and listening related controls

2) Accidental controls performed on the defined objects

The difficulty of differentiation between the function of the objects and listening related controls can be clearly illustrated by the volume up/down by using the zip of a jacket. One may question that what happens if the user is cold and wishes both to close his/her jacket and volume down at the same time. If such aesthetics of interaction are tried to be achieved, the most short cut solution can be a similar zip detail used another place of the jacket or any other clothing of the user.

However, this example can be handled completely in a different way by analyzing the relationship between the nature of the control (increase and decrease in the sound volume) and the use of zip (increase and decrease in the height of the zip). This way other ways of aesthetic interaction can also derived from this meaningful relationship. Such analysis will be provided under the sub-topic- 'The relationship between the nature of the control and the physical manipulations and gestures"- of the discussion.

Another concern related with the reinterpretation of the existing physical affordances of the objects is *accidental controls performed on the defined objects*. Especially in the examples provided for pause/play, the sudden temporal touches on the surfaces may also be performed accidentally while travelling with music.

To avoid such situations, particular solutions can be provided by exploiting the strengths of again tangible interactions:

- Determining the duration of the control (e.g. the duration of touch, stretching), determining the amount of physical change or force (the amount of creasing, the force of tapping), identifying the control area (e.g. differentiation with the textural and visual properties) can deal with the problem of accidental controls, or the differentiation of controls from other instrumental/non-instrumental actions.

- In this regard, the exploitation of material properties (Figure 5.31) becomes more significant to increase the opportunities of differentiation, to strengthen the relationship between the physical manipulations and the nature of controls, and to enhance the aesthetic experience of the users.

Figure 5.31 The exploration of different materials (elasticity) to perform pause/play by pulling the stripe of the umbrella

- Feedbacks and 'feedforwards' (Locher et al., 2010) become more important considering how designers should communicate how long a surface is pressed, how long an object is stretched, how far/ how fast an object is moved. It is also essential to give visual, audio or haptic feedbacks according the type of the control to confirm users that the control is successfully performed.

The Activity-Control Relationship

As mentioned throughout the thesis, mobile listening activity is realized with other activities in public environment, although it is not possible to foresee all of them; travelling with public transportation and shopping can be given as examples. According to Dourish's (2004) definition of context as a relational problem, each activity changes the way the context influences the interactions. Therefore, the discussion of applicability of particular interaction styles to mobile listening necessitates considering these accompanying activities as well. This analysis also makes use of the concerns derived from the activities performed in Study 2 'Living in the Journey' to elaborate the potentials and/or limitations of the proposed controls.

To illustrate, when users are standing up in their travel with public transportation it is more difficult to perform the controls which requires using two hands together. Therefore interactions in the above-mentioned examples such as bending the earphone cables to increase/decrease volume, (Figure 5.9) or sliding the zip to increase/decrease volume (Figure 5.19) should be reconsidered so that users can perform them only with one hand.

When possible *division of attention* of mobile listeners is considered, it can be stated that most of the examples presented earlier enable the user to switch between his/her private mode of listening and public mode in a subtle way. This can be both achieved through the accessibility of controls and the variety of modalities within the interaction. In other words, firstly by making use of the clothes or accessories that are ready at hand, tangible interactions help users to access controls quickly and to better deal with 'sonic interchanges'. Second, tangible controls as an alternative to graphical user interfaces eliminate the user's need of dividing his/her visual modality into different tasks at the same time.

How to Interpret the Selection of Objects for the Controls?

Another issue in this discussion is whether the type of the product or the way the product is used should be taken into account. The answer is both.

The type of the product is important when its use in a particular activity directly affects our mobile listening interactions. In the example of pausing the song by opening the wallet in a purchase (Figure 5.14), the use of *wallet* is as important as the act of *opening* since it is the most obvious alternative (product) that gives a clue about the purchase, which is said to require more concentration than the music and creates the need of pausing the song.

Aside from *what* is used, *where* the object is used (on body) gives clues about the accessible points of control; and, *how* it is used makes us elaborate the relationship between the controls and the physical manipulations. In previous section with responses of participants, 'Depiction of potential areas to attach controls' (Figure 5.13) category has dealt with the *where* question, while 'Reconceptualisation of daily objects as means of controls' category has dealt with the *how* question. The analysis of 'how' -the relationship between the nature of controls and the physical manipulations- will be provided as well, after having discussed gestural controls.

Technological Applicability

Most of the examples presented in the generative session with mobile listening devices and daily objects can be regarded as either tangible or organic user interfaces considering the level of flexibility in the physical manipulations. To illustrate, controls like opening the wallet or attaching the fasteners of a backpack can be regarded as different forms of 'switches', which are quite feasible. Furthermore, the controls performed through altering the place or orientation of the objects can be sensed by RFID trackers as in the example of changing the place of music player to change the playlist. Some manipulations that derived from the movement of an object in 3d space such as taking headphones off to pause, or changing the distance between the ring and the earring to volume up/down require integration of sensors which are able to track motion, proximity and so on. There were also more 'organic' manipulations such as creasing the skirt to shuffle or stretching an elastic bracelet to play/pause. These controls may be realized with the integration of the technologies utilized for organic user interfaces such as 'flexible input technologies' or 'capacitive electric field sensing' as mentioned in Section 2.7.2.1 in Chapter 2.

5.4.3.1.2 Gestural Controls

The evaluation of the examples given for gestural controls is quite parallel with Norman's (2010) critical analysis of gestural interfaces. The issues which will be elaborated under 'Gestural Controls' include *'social constraints', 'other constraints and possibilities', 'the activity-control relationship'*, and *'technological applicability'*. Norman (2010) questions the usability of gestural interfaces because of the invisibility of the affordances and feedbacks. In other words, gestural controls are neither afforded before interacting with the system; nor they leave any visible trace of interaction behind.

Social Constraints

It is observed that participants felt reluctant when they were asked to perform the listening related controls through their bodily movements or gestures. It was mentioned that this reluctance stems from the fact that other people in public environment may not make sense of the gestures, or associate different meanings to these gestures rather than their intended function; which creates a weird situation.

The issue of not being understood by others can be approached by looking at the cultural significations (du Gay et al., 1997) of these interactions (as practices). One should instantly observe a gesture to make sense of it, otherwise the invisibility of affordances and lack of traces postpones the realization and identification of the practice by others. Therefore it takes time for gestural controls to become a part of our know-how.

Hence, one of the reasons behind why participants mostly preferred using objects in gestural controls as controllers can be explained with need of increasing the visibility by involving an element of reference for other people.

Other Constraints and Possibilities

As mentioned under tangible controls, gestures may also cause some accidental controls depending on the fact that the bodily movement defined for the control is performed for another reason or unintentionally.

An accidental control can occur when user's bodily action is regarded as a gesture. To illustrate, waving hands to the friends can be mixed with sliding hands to skip songs (Figure 5.25). Not only the interactive system but also other people can experience difficulties to decipher the gestures.

To avoid such situations, particular solutions can be provided to differentiate particular gestural controls from other bodily movements.

- For full-body gestural controls, the duration, repetition and speed of the bodily movements, or the 3d space defined by the user's movement can be determined in advance. This way a gesture can be more specified with one or more of these parameters.

- The gestural system can be designed in a way that users can both hold and activate when they wish. If the means of activation is placed somewhere accessible by the user, he/she can turn on the system in a way that the bodily movements are only taken into account as gestural controls. Attaching or detaching a clip to the short to sense foot gestures (Figure 5.26) illustrates such differentiation. The gestures performed with the pieces of jewellery also constitute a nice example in terms of accessibility of the ring as an activator of the gestural interface.

- Since there is no physical trace left behind after a gesture is performed, users need to be confirmed that the system has received their input, with audio, visual or haptic feedbacks.

- It does not seem possible to create affordances for gestures. However, when it comes to touch gestures the control area can be defined physically with changes in textural properties of the touch sensitive surface. Such idea has already been offered to be applied to headphones with touch gesture controls by the participants of 'Living in the Journey' study who tried using Rhythmz headphones as well.

Activity-Control Relationship

As tangible controls, some gestural controls should also be reconsidered not only with regards to mobile listening but also other public activities which directly affects our listening experience.

The gestures performed with *two hands* such as clapping hands to play/pause (Figure 5.23) may not be applicable if the user's hands are full with bags, or he/she stands on the bus. This gesture also sounds, which can cause reluctance in users who do not want to attract attention of the others. These sound-related concerns also go for the example where the controls are realized by the whistles of the users.

In the analysis of the Study 2, proximity is provided as a dimension of user-user interactions which brings about the concern of the inability of users to control their device when they do not have enough space in between the people standing/sitting next. This concern is also applicable to the gestural controls. Some gestures define a relatively larger *3d space*; as in opening arms (hands) in certain distance to volume up and down (Figure 5.24). It is also questionable if such bodily movement can be performed in a crowded train or street. Despite these questions concerning the appropriateness or applicability of such gesture, one can still make use of the proximity of two physical means of interaction to symbolize the scale of the sound.

Referring to 'division of attention', one can also talk about *division of body* as well. Some bodily movements cannot be performed at the same time. For example the 'foot gestures' (Figure 5.26) presented above is only applicable when user is sitting; otherwise he/she should keep interrupting his/her walking to control the music.

Technological Applicability

The gestural controls (the tangible controls as well) performed by the participants in generative session should be regarded as source of inspiration rather than the controls that will be applied to the new interfaces directly. Nevertheless, this section will briefly discuss whether some controls are technologically applicable or not. Even though each gesture requires a specific analysis, it can be argued that some of the full body gestures which are normally tracked by stable camera (computer vision)

systems through infrared sensors (Saffer, 2008) may not be applicable to mobile listening considering the mobility of the user. Other moving elements in public environment can also constitute problems. However the stabilization of tracking or sensor system can be realized by embodiment of the system in another wearable/portable object to follow the bodily movements.

5.4.3.2 The Relationship between the Nature of Controls and the Physical Manipulations

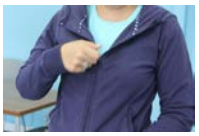
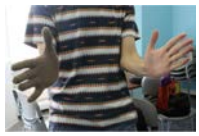
This generative session showed how users' familiarity with physical world can be exploited to conceptualize new interfaces, which is presented as one of the main strengths of tangible computing by Shaer and Horneceker (2010) and Dourish (2004).

The objects provided in the venue were quite simulative for the users that they could easily construct new relationships between their physical affordances and music related controls through 'tangible thinking' (Shaer and Hornecker, 2010). Participants explored the potentials of different sensory modalities ranging from taste to kinesthesis for aesthetics of interaction which is indeed defined as the product's ability to "delight user's one or more sensory modalities" by Desmet and Hekkert (2007, p.58).

This section will analyze the aesthetic (use of senses) and meaningful (use of metaphors or other significations) relationship between the nature of controls and the tangible and gestural interactions.

In terms of this analysis, it is essential to underline that the classifications in Table 5.4 shows alternative ways of performing controls and the metaphorical relationships between these alternative interactions and the nature of the controls. It does not present a 'formula' that should be applied to new interfaces. In fact, the examples provided in this section can be alternated and diversified with other generative sessions.

Table 5.4 Main types of physical manipulations performed in the generative session for the main controls

pause-play 	 reversing  opening/closing  tapping/touching  stretching  pulling + releasing  clapping hands   opening/closing hands
Skip forward/back 	 pulling the right/left side  tilting towards right/left  turning CW/CCW  sliding hands
volume up/down 	 bending  sliding  swiping  turning CW/CCW   pointing up/down  opening hands to sides

Play and Pause

Play and Pause was performed by reversing things inside out/inwards outwards, opening or closing, fastening and releasing, tapping, pulling, stretching , pulling and releasing, clapping hands, opening hands

The active and inactive modes of listening were represented with inside/out, open/close (both objects and hands) binaries. They all can be associated with the sudden change of current situation (listening/not listening). The manipulations like stretching and pulling may have connections with user's past experiences with pull-

cord switches of lamps. This can be regarded as the reflection of practices and meanings offered by one product to another domain.

Skipping back and forward

Skipping was realized with pulling the right or left side, tilting something towards right and left, turning something clockwise or counter-clockwise, sliding hands towards the right and left.

Forward/back was represented with clockwise/counter-clockwise or right/left. These actions generally consist of linear movements in horizontal axis and circular movements. Why the vertical axis (which corresponds to the front and back of the user) was not used is questionable. This may be related with the user's constant interactions with 2d graphical user interfaces where skip forward and back is usually placed on the right and left.

Volume up/down

Volume up/down was realized with sliding something up and down, bending (cables), swiping a surface, turning something clockwise/counter-clockwise, pointing up and down and opening hands (proximity of the two hands)

Up-down was represented as up-down and clockwise-counter-clockwise. The physical manipulations of objects or gestures mainly defined a distance in other words the scale of the volume is invisibly or visibly constructed with the proximity of two different means of interaction.

Another interesting point is the use of 'turning clockwise-counter-clockwise' for both advancing the songs and adjusting the volume. This can be explained by the use of knobs which are diversified with the graphics and used for the both functions in other products.

Shuffle and other controls

In shuffle controls the random order of the songs is associated with physical manipulations and gestures which create a messy look such as creasing (the skirt), shaking (bottle), and scattering (hair).

The examples continue with the interaction alternatives of other additional features or controls such as selection of songs and playlists, like and track selection according to the pace as mentioned within the results.

Tracking the commonalities among different physical manipulations (see Table 5.4) and gestures can help us to understand the aesthetic and meaningful relationships between the controls and these actions. It is the only way of going beyond the examples provided in the session. Such classifications also become useful when they are compared with the capabilities of technology (material, computing etc.) to see in what extent they can realize these physical manipulations or gestures.

Nevertheless, it should be underlined that the technological feasibility and possible transformation of these manipulations to the literal controls can only contribute to aesthetic experience when it takes all the contextual concerns into account as mentioned above.

Designers should also keep in mind the meanings constructed within these interactions as well. For example 'bending' (the wire) for volume down only makes sense with the 'water in the pipe' metaphor.

This part already touched upon the use of "embodied metaphors" in controls (Bakker et al., 2009). Last part of the discussion will also elaborate such representational relationships by not necessarily looking at the controls this time.

5.4.3.3 Beyond the Controls: Representational Relationships

It is observed that, in the generative session, daily objects were used not only as means of control but also to provide new representational relationships.

Use of different pieces of one jewellery set as controllers of gestural interface also brought the idea of presenting this jewellery as the playlist or an album with a specific genre. As mentioned earlier some participants associated pearl with classical music and iron/steel with metal music. As well as this material-genre correlation, another example is based on the idea of taste-album relationship in which an album is released in the form a biscuit, and every song with its own taste starts to play when the user starts to chew it.

All these examples also point out such scenarios where the t-shirts and other accessories with music bands' logos will turn into the media where people access their songs.

These scenarios can be regarded as reincarnation of physical music storage media which became obsolete with the introduction of MP3 in different forms. Each object (a piece of jewellery, a package of biscuit or a band t-shirt) through which people access music is expected to offer its own practices as what cassettes and CDs have done.

To sum up, the analysis of this generative session has aimed the discussion of potentials of these new types of controls rather than providing definitive results. This explorative study shows how the user's aesthetic relationship with the controls can be enriched thanks to the exploitation of diverse physical affordances and material qualities of daily objects, as well as the embodied metaphors within the bodily movements/gestures. It also shows that how these explorations contribute to the construction of new meaningful relationships with music media.

5.5 Summary

This chapter has presented the analysis of three progressive studies conducted within the fieldwork of this thesis: Study 1 'Telling about the Journey', Study 2 'Living in the Journey' and Study 3 'Dreaming about the Journey'. As mentioned earlier, whereas the first two studies aimed at understanding the influence of contextual factors on mobile listening in public environment by utilizing different methods,

Study 3 aimed at utilizing contextual elements within the mobile listening activity for the conceptualization of new aesthetic interactions.

The analyses in this chapter show that the studies reached their aim by answering the questions of how context of use affects mobile listening interactions and how the embodied objects and actions can inspire or transform into the aesthetic means of controls of mobile listening media.

First of all, the analysis of Study 1 presented the results of the session conducted by five participants who were expected to reflect their previous experiences on a table which divides the mobile listening experience into several stages to be evaluated according to particular categories.

The analysis of Study 1 revealed the main concerns of the participants about listening on-the-go in public environment such as presence of other people, accessibility to controls and division of attention. Then these concerns were classified into user-user, user-product and product-product interactions to better illustrate from which domain of interaction these concerns derive and how they are actually interrelated with other interactions within the environment. These relations were also presented in a diagram which combines the main arguments of Domain of Interaction model (Şener & Pedgley, 2014), Product Ecology Framework (Forlizzi, 2007) as well as compositional and spatio-temporal threads of user experience (Wright et al., 2008).

Secondly, this Chapter provided the analysis of Study 2. In this study participants used one of four specific types of mobile listening devices in the city, while performing different types of activities or tasks. These activities or tasks which users went through were determined according to the main themes derived from the first study, involving challenges in terms of social interactions and division of attention.

The results of Study 2 added to the results of Study 1 by diversifying and getting deeper into the concerns presented under user-user, product-product and user product interactions. For instance, 'portability' under the title of product-product interactions was detailed with the main reasons behind the portability decisions of the

participants, which gives more clues about how users prefer using daily objects for a more comfortable mobile listening experience.

The variety of products and interfaces also enriched the analysis of the users' interaction with product in different activities. Study 2 showed that the users' concerns related with accessibility to controls, safety of the device/belongings, or freedom of movement start to diminish through embodiment of mobile listening media (e.g. through wearability) and controls (e.g. utilizing larger interaction areas with touch gesture controls compared to button-based controls). The analysis of Study 2 also contributed to Study 3 by providing an underlying experience as well as by presenting a list of concerns to be referred in the discussion of Study 3.

Lastly, the Chapter presented and discussed the results of Study 3. It was a generative session in which four participants from the previous study were asked to perform controls by utilizing gestures and the daily wearable or portable items that accompany users while listening to music on-the go. In parallel to the four stages of the generative session, in the analysis, the responses/performances were grouped as non-instrumental interactions and alternative ways of controlling available devices, utilization of daily objects, utilization of gestures, and exploration of different sensorial interactions.

The examples were further discussed by looking at, first, their limitations and potentials considering the activities performed in the public context of use; second, their relationship with the nature of controls (e.g. volume up/down-sliding up/down). Finally, the analysis switched from controlling music through objects/gestures to the representation of music through rich sensorial aspects of the objects (e.g. material-genre relationship).

Study 3 revealed that how physicality offers rich opportunities for aesthetics of interaction of mobile listening media. Such richness stems from:

- the limitless options for physical affordances (e.g. *for* pulling, stretching, turning),

- the use of diverse material properties (e.g. texture, elasticity, and deformability),
- the use of 3d spatial relationships (e.g. proximity, movements towards up/down, right/left)
- the use of different sensory modalities (taste, sound, tactility, kinesthesis)

However, utilization of such richness embodied within the context is only meaningful, when it is considered with the challenges in the context. That is why the analysis of 'Dreaming about the Journey' evaluated these 'dreams' with a critical approach referring to the insights driven from Study 1 and Study 2. In other words, it did not only present inspiring examples but also questioned the potentials of these examples. This way the tri-partite fieldwork achieved the aim of providing an analytical overview of the challenges and potentials of the context in terms of aesthetics of interaction of mobile listening media.

CHAPTER 6

CONCLUSION

The aim of this thesis was to *explore the potentials of embodied interactive technologies to enhance mobile listening in public environment.* The questions that would guide the research were structured in a way that the thesis could define mobile listening experience, discuss its relations with the public context of use, present different forms of embodied interaction and assess their potentials for aesthetics of interaction of mobile listening media. This thesis tried to find answers to these questions by both consulting the literature and users of mobile listening media in fieldwork. The fieldwork involved three progressive qualitative studies that aimed to gain insights from users by encouraging them to share their previous experiences (Telling about the Journey), to instantly reflect on their experience (Living in the Journey), and to generate alternatives to their experiences (Dreaming about the Journey).

This chapter will present the prominent insights of both literature review and the tri-partite fieldwork of this thesis. It will mainly articulate the way this study defined mobile listening and the way it explored the relationship between the context and mobile listening (user) experience. The chapter will also draw upon the embodiment of mobile listening controls, the practical concerns regarding their application to the context and finally their contribution to the aesthetics of interaction which constituted the major focus of this thesis. The chapter will conclude by pointing out the possible ways of applying the insights of this thesis to different fields and suggest pathways for further research.

6.1 Defining Mobile Listening Experience

The insights presented under this title give answers for the question(s) of what *mobile listening (experience) is and how it has evolved until today*. These questions found their answers in Chapter 2 and Chapter 3 which constituted the literature review of this study. Although mobile listening can be simply defined as 'listening on-the-go', in the literature it gains different significations depending on how it is approached.

- **Mobile listening as a cultural practice**

  In Chapter 2 'Mobile Listening as a Challenging and Inspiring Mobile Listening Experience', it has been stated that culture is shaped with meanings and practices, and each new technological media reproduce culture by bringing about new meanings and practices (du Gay, et al., 1997). Therefore, it should be underlined that what has been discussed throughout the thesis through users' interactions with mobile listening media actually refers to the meanings and practices that form the culture.

- **Mobile listening as privatization of (public) space**

  Mobile listening was also defined as privatization of public space through the *auditory bubble* users create with music (Bull, 2005). Listening to music in public environment was illustrated with being in two simultaneous sound worlds in which *sonic interchanges* between these worlds are inevitable (Thibaud, 2004). Therefore, one of the focus points of the thesis was the seamless and subtle transition between these worlds enabled by controls. This was also reflected in the organization of Study 2 'Living in the Journey' where participants dealt with sonic interchanges.

- **Mobile listening as a user experience**

  The thesis argued that mobile listening is not a mere experience, but it is a user experience and this was justified through *users'* interactions with the *mobile listening media*.

- **Evolution of mobile listening experience**

  Chapter 3 'Evolution of mobile listening experience' first elaborated the transition from listening to mobile listening and from portable music players to personal portable music players with the introduction of Sony Walkman in 1979. Then, the Chapter showed how users' (aesthetic) interactions have changed through the introduction of new sound technologies or products. For instance, it was argued that the introduction of MP3 file format dematerialized users' relationship with music storage media.

  The evolution also involved the contemporary trends. Especially in terms of embodiment, contemporary products such as wearable music players or headphones with touch-gesture controls showed that companies have started to think beyond the available devices and GUI/button-based controls as this thesis aims to portray.

6.2 The Relationship between the Context and Mobile Listening (User) Experience

Having viewed the diverging definitions of mobile listening, this part will explain how the conceptual frameworks provided in the literature review and the studies conducted within fieldwork contributed to the analysis of contextual factors affecting mobile listening experience in public environment**.**

6.2.1 Underlying Conceptual Frameworks

As mentioned throughout the thesis, exploring the potentials of embodied interactive technologies to enhance mobile listening experience in public environment requires understanding both contextual factors implying on the user experience and also the potentials 'embodied' within the context. This section presents the insights related with the question of *'What are the factors influencing current user-user, user-product, product-product interactions in mobile music listening experience in public environment?'* Then, the following section will focus on the potentials 'embodied' within the context.

To discuss contextual factors in mobile listening experience, the literature review presented varied definitions of context. In this case, Dourish's (2004) approach to the context is quite critical, which elaborates context *as a relational problem* and claims that the influence of the context depends on the type of activities. Hence, that is why Study 2 'Living in the journey' involved different activities to be performed within the journey, details of which will be given in the later sections.

In the literature review, the relationship between the context and user experience was articulated with particular user experience frameworks that put special emphasis on the context. This articulation was important to understand how user-product interaction defines a *domain of interaction*, and how this *domain of interaction* is actually a part of *product ecology* which includes user-user interactions as well. All these definitions or models related with the context constituted a frame to analyse the results of the fieldwork under *Study 1* and *Study 2*.

6.2.2 Fieldwork: *Telling about* and *Living in* the Journey to Understand the Context

Study 1 'Telling about the Journey' was conducted as a session where five participants were expected to reflect their concerns about different stages of mobile listening activity by appropriating the method of customer journey mapping. One of the most significant insights gathered from the study was that users' concerns about mobile listening in public environment are not only related with product features but also with other factors such as presence of other people and portability. In other words, it showed that how user-user (social) interactions and product-product interactions affect the way users interact with mobile listening devices. The analysis of the context through the links between user-user, product-product and user-product interactions was made possible by taking both *domains of interaction* and *product ecology* models into account within a diagram.

Study 2 'Living in the Journey' was conducted as a literal journey where the participants were asked to use one specific mobile listening device while performing different tasks/activities in an urban setting. These activities were determined according to the concerns derived from Study 1 to make mobile listening activity in

public environment even more challenging by involving the users in occasions that require more social interaction and division of attention.

The results of Study 2 added to the results of Study 1 by diversifying and getting deeper into the concerns presented under user-user, product-product and user product interactions. To illustrate, it provided new dimensions for user-user interactions such as *proximity, appearance, visual detachment, audio detachment, alternative ways to communicate, privacy, and sharing music.* All these social dimensions have practical reflections in user-product interaction. For example, in terms of *proximity*, not being able to perform the controls that require 3d space in crowded areas also becomes a concern for the embodiment of controls through gestures. Furthermore, all participants stated that they took their earphones/headphones off as a reflex when they were about to involve in a conversation. Such *reflexes* performed by users to overcome both *audio and visual detachment from environment* also constitute an inspiration for the design of intuitive interactions.

6.2.2.1 Comparative analysis of Different Types of Interfaces in relation to the Context

In Study 2, testing of four different mobile listening devices with different features and interfaces also enabled a comparative analysis of user-product interactions in relation to the context. This analysis also gave answers to the research question of *"In which way users prefer to perform listening-related controls and get feedback while they are on-the-go in public environment?"*

According to the responses received from all participants, it can be argued that, for the main controls (i.e. play/pause, volume up/down and skip forward/back), general preference is towards using button-based controls without paying a visual attention or dealing with the GUI on the screen. However, button-based controls have become challenging with the tiny portable MP3 players with scaled down control areas. Unless the product is wearable, accessibility to button-based controls also emerges as an issue depending on where users carry the product.

The occasion in which graphical user interfaces were utilized most was when the participants wanted to view the track info and select a song from the menu. It was presented as the biggest advantage of GUIs over eyes-free/button-based controls where users had to skip back and forward constantly to find a specific song. This showed that the advantages and disadvantages of a specific interface in relation to a context also depend on the type of control.

Participants also shared their concerns about the headphone with touch-gesture controls. The problems were mainly related with *the sensitivity of the surface, reliance on the physical (repetition of gestures), and undefined interaction area*, whereas the positive comments were more about the aesthetics and *fun* aspects of the swiping gesture itself and *"subjective interpretations"* (Ferneaus et al., 2008) such as performing controls on the headphone by turning head instead of swiping fingers.

6.3 Embodiment of Controls: Exploring Potentials in the Context

Beyond its challenges, the context also presents inspirations for the design of aesthetic interactions through embodiment of controls. This section will present how embodiment of controls has been elaborated throughout this thesis by referring both to the literature review and the fieldwork as in the previous section.

6.3.1 Underlying Contextual Frameworks

The insights that will be shared in this section constitute answers to the research question of *"What aspects of embodied interactive technologies such as tangible user interfaces and gestural interfaces contribute to the experience of mobile listening considering their appropriateness to the public context of use?"*

In the literature review, the potentials of the context for user-product interactions were explained through the concept of embodied interaction (Dourish, 2004). In this thesis embodied interaction was used as means of aesthetics of interaction, because aesthetics of interaction also results from users' physical relationships with the world. Therefore, the literature review articulated different types of interaction models which exploit the "users' familiarity with the physical world" in interactive systems (Shaer & Hornecker, 2010).The first example was tangible user interfaces (TUI) in

which "physical objects are used as controls or representation of data" (Ullmer & Ishii, 2001). The overview continued with organic user interfaces that also combine physicality with computing; but enable more flexible physical manipulations of objects through changing their shapes by bending, squeezing, folding and so on. However, physical objects are not the only means of input. Gestural interfaces, which utilize bodily movements as controls of interactive systems, were also discussed as a type of embodied interaction.

These interface models offering different types of physical manipulations have their own strengths and weaknesses. To present the whole picture, these strengths and weaknesses will be discussed with reference to both the literature review and the results of Study 3 'Dreaming about the Journey' after elaborating its role for the thesis.

6.3.2 Fieldwork

The last study of the field work 'Dreaming about the Journey' was conducted to explore the possible embodied interactions for mobile listening controls. It was a generative session in which four participants from Study 2 were asked to perform the main controls through alternative use of mobile listening devices, daily objects and gestures. The participants were also encouraged to use as different sensorial modalities as possible not to limit the aesthetics of interaction to visual, tactile or kinesthetic senses, but also to think of other alternatives. The results of Study 3 can be examined according to the main means of interaction (devices, daily objects, gestures) utilized in the session.

First, users presented alternative controls of available mobile listening devices by transforming non-instrumental interactions and other physical manipulations to the controls. Bending cables to volume down (with a pipe metaphor), reversing the MP3 player to pause and changing the place of MP3 player to change the playlist can be given as examples. These examples showed that the potentials of physical qualities of available products have not been exploited enough to enrich the interactions.

Secondly, the participants utilized daily objects, clothes and accessories provided in the venue to perform controls. While some examples just defined new accessible places for controls, others made use of these objects by reinterpreting their physical affordances and material properties. Some examples were inspired from the accompanying activities performed with mobile listening; such as pausing the song when the wallet is open to concentrate more on the purchasing process.

Thirdly, the participants performed the controls through bodily movements/gestures. These gestures can be illustrated with clapping hands to play and sliding hands to skip songs.

Finally, different sensory modalities were exploited in controls. Touching the roughest surface of the necklace to shuffle, eating a specific biscuit to listen to a specific song, commands via whistles or speaking can be given as examples to various uses of sensory modalities in interaction.

The following overview of the thesis's insights for embodiment of controls will discuss the examples provided in Study 3 in relation to their practical aspects (applicability to the context) and their potentials for aesthetics of interaction. This section utilizes these examples as a reference point to discuss the potentials and limitations of embodied interactions. As mentioned earlier, these potentials and limitations will be the combination of what has been elaborated in the literature and what has been explored in the fieldwork.

6.4 Practical Concerns

The practical concerns presented in this section mean the applicability of controls to the mobile listening in public environment. These concerns will be presented separately for tangible and gestural controls, because of their particularities such as having or not having physical affordances which highly influence the interaction as mentioned in the analysis of Study 3 in Chapter 5.

Tangible Controls

Now, the limitations and potentials of both tangible and organic user interfaces will be articulated, since the examples in fieldwork have different levels of flexibility in physical manipulations.

Limitations of Tangible Controls

Some limitations are related with the reinterpretation of (perceived) physical affordances.

- ***The difficulty of differentiation between the function of the objects and listening-related controls*** emerged as a limitation in Study 3 as in the example of sliding the zip of a jacket downwards to volume down even though it is cold. Nevertheless, such concerns can be solved by taking this aesthetics of interaction as an inspiration but not necessarily applying it to another interface in the 'functional' zip format.

    - ***Accidental controls:*** The examples in which pause/play is realized with the sudden temporal touches on the surfaces may also be performed accidentally while travelling with music.

      Analysis of Study 3 also included possible solutions to such concerns by determining the duration of the control (e.g. the duration of touch, stretching) and the amount of physical change or force (the amount of creasing, the force of tapping); and identifying the control area (e.g. differentiation with the textural and visual properties).

- ***Controls demanding the use of two hands together*** may be technologically feasible but pose problems in occasions such as standing in a minibus or carrying bags.

- ***User fatigue:*** Reliance on the physical was also presented as a limitation of TUIs in the literature review. It wasn't mentioned in the fieldwork analysis since users performed each control only once.

Potentials of Tangible Controls

- ***Controls ready-at-hand:*** It can be claimed that utilization of already portable and wearable objects as 'resources of action' as what participants did within Study 3 decreases the concerns such as ***accessibility to controls*** or ***safety of the device and other belongings***.

- ***Less reliance on visual modality*:** Replacing the main controls performed with GUIs with tangible ones can bring a solution to the mobile listeners' problem of division of attention. However, when it comes to more complex controls such as song/album selection, the use of TUI over GUI should be considered again, since all items of music cannot be represented by tangible objects. However, one participant came up with an alternative idea in which users can change at least the playlist by placing the music player in different places on clothes. Creation of such a physical layout for the playlists is inspiring for dealing with complexity in TUI design.

- ***Portability of 'tangible objects'***: In the literature review, portability of tangible objects was mentioned as a limitation of TUIs especially in complex interactive systems which demand high number of tangible objects. However, this concern was not applicable to the basic/main mobile listening controls which can be performed through the physical manipulations of one or a few physical items. In fact, since the objects manipulated in Study 3 were already portable and wearable ones, portability was not a concern.

Gestural Controls

This section presents both context-related (mostly derived from the field studies) and interface-specific (mostly presented in the literature review) limitations and potentials of gestural interfaces.

Limitations of Gestural Controls

- ***Lack of physical affordances and feedback*** The limitations of gestural controls mainly stem from the lack of physical affordances (a problem highlighted by Norman, 2010) which affects both user-user and user-'product'

interactions. In terms of user-product interactions, it makes it harder to understand how the interactive system is controlled.

- ***Lack of feedback:*** Since there is no trace left behind gestural controls (Norman, 2010), it is harder to provide feedback to ensure the users that their gestures are processed by the interactive systems.

- ***Reliance on the physical (User fatigue)*** was another limitation of gestural controls mentioned in the literature. Indeed, controlling music with gestural controls was presented as a tiring process by one participant who tested headphones with touch gesture controls in Study 2.

- ***Social constraints:*** In gestural interfaces the invisibility of affordances may lead other people in the environment not to make sense of these gestures or interpret them in a different way. Participants of Study 3 indeed expressed their reluctance to explore gestural controls for the same reasons. This concern had also been elaborated under 'unprecedented forms of controls' within Study 2 during the discussion on the relationship between the way of controlling products and the way the users are perceived by others. Such concerns, as argued in the study, stem from the fact that the invisibility of affordances postpones the formation of a cultural signification of the control as a practice associated with mobile listening.

- ***Proximity:*** Gestures define and require a 3d space to be performed. Considering the intensely crowded public settings, the size of interaction space defined by the gestures can be problematic.

- ***Accidental controls*** can occur when any of user's bodily action is regarded as a gesture without users' intentions.

- ***Division of 'body'***: Performing particular bodily controls while walking can be challenging as in the example of foot gestures performed in Study 3.

Therefore, no matter how technologically applicable a gesture is, it requires considering the mobility of the users.

These titles that are listed as limitations, put limit on the applicability of controls, but they do not make them totally impossible. For instance, as discussed in the analysis of Study 2, limitations regarding lack of physical affordances in touch gesture surfaces can be solved by adding textures to define the interaction area, or visual/physical feedbacks can be alternated with audio ones. In other words, solutions could be realized through multi-modality as touched upon in the literature review under 'multi-modal interfaces'.

Potentials of Gestural Controls

- **Elimination of the need of hardware:** It was stated in the literature review that using body as an input for controls eliminates the need of using and carrying hardware (Saffer, 2008). This feature perfectly fits to mobile users for whom carrying an extra item for the controls can be a burden. Such elimination also contributes to the erase of other concerns related with mobile listening in public environment such as ***accessibility to controls*** and ***safety of the 'hardware'*.**

6.5 Aesthetics of Interaction

The previous section has shown how this thesis discussed the relationship between different forms of embodied interaction and the context through practical concerns. This section will touch upon how the potentials of embodied interactive technologies for aesthetics of interaction are explored throughout the thesis.

As aimed, this thesis demonstrated how the use of physicality in interactive systems can enrich and aestheticize interactions. In this regard, as mentioned at the very beginning of the thesis, the use of contextual elements that gains mobility with mobile listeners such as daily wearable or portable items constituted great examples to figure out the possible embodiment of controls again within these daily items or in other forms. Beyond the role of daily items, the users' body, as an embodied part of mobile listening activity was also handled as a means of controls.

This section will share which dimensions of physicality contribute to the aesthetics of interaction of mobile listening interactions by appealing to users' different sensory modalities.

Variety of physical affordances through differences in form, size, texture play a stimulating role for performing mobile listening controls with a variety of physical manipulations such as pulling one. This variety can be exemplified with diverse manipulations for play/pause through tapping, opening /closing, pulling and so on.

Variety of material properties is another factor that enriches the physical manipulations by providing more flexibility in controls; such as using *deformability* to roll cables for shuffling and stretching an *elastic* bracelet to play/pause.

3d spatial relationships can refer to change of places (changing the place of MP3 player to change the playlist), proximity between different items (controls based on the distance between the earring and ring), moving up/down or right/left (sliding hands to skip songs). The speed or repetition of the movements can also be associated with the nature of controls as in the example of shuffling through shaking.

Different sensory modalities: With the introduction of physicality, the sensorial experience is no longer confined into the sight and touch as in GUIs and button-based interfaces. With embodied interactive technologies, it is possible to make use of kinesthesis as well. Indeed, Study 3 also indicated that, the exploitation of sensory modalities can be furthered by the sound (controls through speaking) and even taste.

6.6 Experience of Meaning

It was observed that the users not only controlled 'music' through physical items, but also constructed some meaningful relationship between these items and the music. This showed that tangible and gestural controls contribute to not only aesthetic experience but also experience of meaning; which brought a new dimension to the thesis as another way to enhance overall mobile listening experience by utilization of embodied elements.

The production of meaning can be illustrated with one participant's use of 'embodied metaphors' in bending cable to volume down by constructing an analogy between the sound in cable and water in pipe. The representational relationships such as an album in the form of a pack of biscuit (taste-genre link), or classical music playlist represented by a pearl jewellery set to be controlled through the proximity between different jewellery pieces (material-genre link) can also be given as examples to the production of meaning. Such representation of music media was defined as *'the reincarnation of tangible music storage media (e.g. cassettes and CDs) in different forms*'.

6.7 Practical Implication of Results

Having articulated the major findings and results of the research, now the chapter will assess how the above-mentioned outcomes of this study can provide inspiration and guidance for different design and research areas. The insights offered in this section mainly follow the keywords that make up the title of this study-"The Potentials of Embodied Interactive Technologies to Enhance Mobile Listening Experience in Public Environment"- and analyze alternative applications in terms of mobile devices, personal products used in public environment and application of embodied interactive technologies.

Mobile devices: This thesis elaborated how mobility affects user-product interactions and users' concerns about the specific type of interfaces in relation to mobility such as 'division of attention' and 'division of *body"*. Such themes related with mobility can be referred to in design of future mobile devices.

Personal products used in public environment: The subject-matter of this thesis derived from the challenge of doing something personal in public environment. Especially in Study 2, users' concerns about the presence of other people (user-user interactions) while interacting with a mobile listening device (user-product interactions) were elaborated in detail. Although some are listening-specific such as audio detachment, most of the concerns listed under user-user interactions such as proximity, safety of the product and other belongings, appearance can be also applicable to other future personal devices that will be used in public environment.

***Application of embodied interactive technologies*:** Evaluation of tangible and gestural controls in terms of practical matters has presented some key points to be considered in any application of embodied interactive technologies. Some of these keywords, such as proximity between people, may not be a concern for indoor use, however there are some keywords that directly stem from the way the user controls the interactive system such as user fatigue, which should be taken into account in design decisions.

6.8 Further Research

The thesis explored the ways of enhancing mobile listening experience through embodiment of main controls of music players. The exploration can be furthered by first with the transformation of the examples presented in Study 3 into working prototypes; and then testing them in a literal journey that could be conducted in the same way with Study 2 'Living in the Journey'. This would enable a comparative analysis of contemporary products (interfaces) with proposed ideas.

The scope of the research can be extended by involving all listening-related controls with different complexities that would demand considering different types of interfaces together. On the other hand, the research can further zoom into specific parts of this thesis such as embodied metaphors that were used to associate particular physical manipulations to specific types of controls.

Summary

To conclude, there is no other thing than the music itself that can most aestheticize the mobile listening experience in public environment. However, this study questioned if this experience could also be enhanced by the way users interact with mobile listening media. To do so, it explored the potentials of embodied interactive technologies for aesthetics of interaction by analysing the elements and actions embodied in context both as a challenge and inspiration. These explorations point out new meanings and practices associated with new types of interfaces, which means that there will be new types of *journeys* for users to take.

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APPENDIX A

INTERVIEW QUESTIONS OF STUDY 2 (Turkish version)

Opsiyonel olarak kullanılan ürünler

- Hangi *kulaklığı* [iPod Nano&Shuffle] */müzik çaları* [Rhythmz Blu HD kulaklık] kullanmayı tercih ettiniz, neden?
- Seyahatiniz boyunca kullandığınız *kulaklık /müzik çalar* size nasıl avantajlar ya da dezavantajlar sundu?

Aktivite Soruları*(Dolmuş , Cadde, Büfe, Kitabevi, Telefon Çağrısı)

- Neler yaptınız?
- Ürünü nerede/nasıl taşımayı tercih ettiniz [giyilebilir olmayan ürünler için]? Neden? ***Seyahat / alışveriş / kitabevi*** ziyareti boyunca veya ***telefon çalınca*** bir değişiklik yaptınız mı, neler yaptınız?
- Hangi kontrolleri kullandınız? Herhangi bir değişiklik yapma ihtiyacı hissettiniz mi?
- Ürünü kullandığınız ortam, ürün ya da ürünün sunduğu kontrollerden kaynaklı bir problemle karşılaştınız mı? (Örneğin; Ürüne ya da üzerindeki kontrollere ulaşmada güçlük çektin mi? Ürünün güvenliği ile ilgili (düşürme-çalınma) çekinceleriniz oldu mu? vb.)
- Ürün ya da ürünün sunduğu kontroller nasıl olsaydı bu problemlere çözüm sunabilirdi? Ürün bu şekilde olsaydı ***dolmuşta / yürürken / büfede alışveriş yaparken / kitabevinde soru sorarken / telefon çağrısı geldiğinde*** daha ideal kullanım sunardı dediğiniz bir şey var mı ?

*Her aktivite için ayrı ayrı yöneltilmiştir.

Ürün/arayüz genel değerlendirme

- Ürünle etkileşiminizde, kullandığınız ürünün malzemesini, dokusunu, çıkattığı sesleri vb. düşündüğünüzde hoşuna giden/gitmeyen şeylerden bahsedebilir misiniz?
- Kontrolleri gerçekleştirme şeklinizden **(*tuşlar / ekran / parmak mimikleri*)** memnun kaldınız mı?
- Geri bildirimler yeterli miydi, değilse ne gibi sıkıntılar yarattı? Yani kontrolleri gerçekleştirip gerçekleştirmediğinizden emin olabildiniz mi?
- Ürün ile evde de vakit geçirmiş miydiniz? Bir karşılaştırma yapacak olursanız dışarıda nelerin değiştiğini söyleyebilir misiniz? Ürünün evde daha rahat bir şekilde kullanılıp dışarıya çıktığında sorun oluşturabilecek kontrolleri ya da diğer özellikleri var mı?

APPENDIX B

INTERVIEW QUESTIONS OF STUDY 2 (English version)

Optionally used products with the main product

- Which *phone* [earphone / headphone for iPod Nano / Shuffle] or which *music player* [for Rhythmz Blu HD headphone] did you prefer to use, Why?
- What advantages or disadvantages did this *phone/music player* bring about to your journey?

Activity related questions* (Travel in the minibus, Travel within the streets, Purchase at the buffet, Consulting someone in the bookstore, Receiving a Phone call)

- What did you do?
- Where did you prefer to carry the device [applicable for non-wearable products]? Why? Did you need to change anything while ***travelling, purchasing sth. and visiting a bookstore*** *or* when you received ***a phone call****?*
- Which controls did you use? Did you feel the need of changing anything?
- Did you face any problem related with the product or its controls? (e.g. problems such as accessibility to the controls and safety concerns (the risk of dropping the device or robbery)
- How could controls be to provide ideal interaction while you were **travelling in the minibus / walking in the street / buying sth. from the buffet / asking a book** from the bookstore staff, and when you received a call?

*The questions are asked separately for each activity.

Product/Interface Overview

- When you think about your interactions with the product, is there anything you especially liked or disliked about how it feels (material, texture) or how it sounds and so on?
- Did you like/enjoy the way you control the device [through buttons /multi-touch screen / touch gesture] or not? Why?
- Were feedbacks enough to ensure that you performed the controls?
- Did you use the product at home? Would you say what changes in public environment compared to the home? Was there any feature of the device that makes it easier to deal with the product at home but not outside?

APPENDIX C

Participant no.....
Date.....

CONSENT FORM 1

Dear Participant,

This study will be used for the thesis that has been carried out in Middle East Technical University, Department of Industrial Design, focusing on mobile listening experience in public environment. In this session, I will kindly ask you to share your previous mobile listening experiences with other participants and me by filling in the chart on the wall (with different stages of listening on-the-go) with the post-it notes provided in the venue.

If you allow, I would like to make a video recording in this session. This records will be used only within the scope of this thesis and will not be shared with third person.

There is no true or false in this study. All statements and comments will enrich the content of the study, so please do not hesitate to state anything that comes to your mind.

You can leave the study at anytime you want without indicating any reason.

Please sign if you admit the written above.

Thank you very much for your participation.

Güzin Şen
Middle East Technical University
Department of Industrial Design
Research Assistant, MSc Student

Age.....

Sex.....

Signature.....

APPENDIX D

Katılımcı No:.....
Tarih:.....

CONSENT FORM 2

Değerli Katılımcı,

Bu çalışma ODTÜ Endüstri Ürünleri Tasarımı Bölümü'nde yürütülen ve 'kamusal alanlarda hareket halinde müzik dinleme deneyimi' üzerine odaklanan bir yüksek lisans tezi araştırmasının bir parçası olarak organize edilmiştir ve iki bölümden oluşmaktadır. Bir mini- seyahat olan ilk bölümde, sizden bir yandan müzik dinlerken size verilen krokide belirtilmiş rotayı takip etmenizi ve belirtilen duraklardaki aktiviteleri gerçekleştirmenizi rica edeceğim. İkinci bölümde ise bu deneyiminizi değerlendirmek üzere bir mülakat gerçekleştireceğim.

İzniniz olursa ikinci bölümde yapacağımız mülakatı detaylıca değerlendirebilmek ve hatırlamak amacıyla çalışmayı video ve/veya ses kayıt cihazı ile kaydetmek istiyorum. Bu kayıtlar sadece bu tez çalışması kapsamında kullanılacaktır ve üçüncü şahıslarla kesinlikle paylaşılmayacaktır.

Bu çalışmada doğru ya da yanlış yoktur. Her ifadeniz ve yorumunuz çalışmanın içeriğine zenginlik katacaktır, bu nedenle aklınıza gelen herhangi bir şeyi ifade etmekten çekinmeyiniz.

Bu çalışmayı istediğiniz zaman herhangi bir sebep göstermeksizin yarıda bırakabilirsiniz.

Yukarıda belirtilenleri kabul ediyorsanız lütfen imzalayınız.

Katılımınız için çok teşekkür ederim.

Güzin Şen
Orta Doğu Teknik Üniversitesi
Endüstri Ürünleri Tasarımı Bölümü
Araştırma Görevlisi-Yüksek Lisans Öğrencisi

Yaşınız.....

Cinsiyetiniz.....

İmza.....

APPENDIX E

Katılımcı No:.....
Tarih:.....

CONSENT FORM 3

Değerli Katılımcı,

Bu çalışma ODTÜ Endüstri Ürünleri Tasarımı Bölümü'nde yürütülen ve 'kamusal alanlarda hareket halinde müzik dinleme deneyimi' üzerine odaklanan bir yüksek lisans tezi araştırmasının bir parçası olarak organize edilmiştir. Bir 'yaratıcı oturum' [generative session] olan bu çalışmada, çalışma mekanında size sunulmuş olan müzik dinleme cihazlarını ve gündelik nesneleri değerlendirerek, ya da beden hareketlerinizi kullanarak müzik dinlerken kullandığımız temel komut ve kontrolleri yeniden yorumlamanızı rica edeceğim.

İzniniz olursa oturumu detaylıca değerlendirebilmek ve hatırlamak amacıyla çalışmayı video ve/veya ses kayıt cihazı ile kaydetmek ve yaptığınız hareketleri fotoğraflamak istiyorum. Bu kayıtlar ve fotoğraflar (kimliğinizi belli etmeyecek şekilde) sadece bu tez çalışması kapsamında kullanılacaktır ve üçüncü şahıslarla kesinlikle paylaşılmayacaktır.

Bu çalışmada doğru ya da yanlış yoktur. Her ifadeniz ve yorumunuz çalışmanın içeriğine zenginlik katacaktır, bu nedenle aklınıza gelen herhangi bir şeyi ifade etmekten çekinmeyiniz.

Bu çalışmayı istediğiniz zaman herhangi bir sebep göstermeksizin yarıda bırakabilirsiniz.

Yukarıda belirtilenleri kabul ediyorsanız lütfen imzalayınız.

Katılımınız için çok teşekkür ederim.

Güzin Şen
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Endüstri Ürünleri Tasarımı Bölümü
Araştırma Görevlisi-Yüksek Lisans Öğrencisi

Yaşınız.....

Cinsiyetiniz.....

İmza.....