PUT THE CONCERT ATTENDEE IN THE SPOTLIGHT. A USER-CENTERED DESIGN AND DEVELOPMENT APPROACH FOR CLASSICAL CONCERT APPLICATIONS

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ABSTRACT

As the importance of real-life use cases in the music information retrieval (MIR) field is increasing, so does the importance of understanding user needs. The development of innovative real-life applications that draw on MIR technology requires a user-centered design and development approach that assesses user needs and aligns them with technological and academic ambitions in the MIR domain. In this paper we present such an approach, and apply it to the development of technological applications to enrich classical symphonic concerts. A user-driven approach is particularly important in this area, as orchestras need to innovate the concert experience to meet the needs and expectations of younger generations without alienating the current audience. We illustrate this approach with the results of five focus groups for three audience segments, which allow us to formulate informed user requirements for classical concert applications.

1. INTRODUCTION

While the Music Information Retrieval (MIR) field historically has mostly been algorithmically oriented, in recent years the community increasingly gained interest in the use and consequences of MIR technology for real-life applications rooted in user needs. Cases for a 'mentality shift' into this direction have been made in [22], [4], [20], [6], [15], and the ISMIR community includes a limited amount of active work on real-world user requirements (e.g. [3], [10], [12], [13]). However, it still seems hard to connect real-world user needs and requirements to concrete technological system and algorithmic advances [14]. When the needs and characteristics of the users are left unaddressed in technological applications, the end user remains an abstract entity, which becomes manifest in the absence of a requirements analysis and untargeted participant recruitment for formative or summative evaluations of systems involving MIR technology.

In this paper, we focus on technological application opportunities targeted at (Western) classical symphonic concert attendance. Orchestras are increasingly worried about audience sustainability. A Flemish study confirmed the common belief that concert attendees are typically highly educated and over the age of 45 [19]. Concerns about an aging audience motivate orchestras to find creative ways to involve new audiences [11], not only with new attractive concert formats, but also with technological innovations that allow users interested in classical music to become engaged in an easy way. Examples include online concert broadcasting (e.g. Digital Concert Hall[1]), smartphone-supported live program notes (e.g. LiveNote[2]), and enriched tablet e-magazines with second screen content (e.g. RCO Editions[3]). As argued in [9], MIR technology has the potential of enriching the customer experience for the users of these applications. Once users become more engaged, they are more likely to buy concert tickets, which ultimately would lead to a more diverse classical concert audience.

However, there is a trade-off between the need for innovations that attract new audiences and the risk of avoiding the alienation of the traditional audience. Since technology is not naturally associated with the classical concert experience and the allegedly conservative audience might be reluctant towards the use of technology in and around the concert hall, the importance of user acceptance cannot be underestimated. Therefore, an innovation approach is needed that combines a technology push from the MIR community with a strong technology pull from user audiences. User-centered design is an important pillar of this approach, addressing user needs from existing and new audiences, and evaluating solutions with end-users in every stage of the design process.

In this paper, we therefore demonstrate how a user-centered design approach can be used to identify opportunities for the use of (MIR) technology in classical concert applications that are grounded in the needs of different audience segments. More specifically, our study seeks to answer the following research questions:

1. What are the motivators and obstacles for different audience segments to (not) attend classical concerts?
2. How can the needs of the audience segments be translated into opportunities for the enrichment of the classical concert experience by means of technology?

Consistent with [9], we argue that the classical concert experience not only involves the concert itself, but also

[1] https://www.digitalconcerthall.com/en/home
[2] https://www.philorch. org/introducing-livenote%E2%84%A2-nights#/
[3] www. concertgebouworkest.nl/en/rco-editions

the preparation beforehand, and reflection and re-experience afterwards. The envisioned applications are intended to appeal to new audiences by yielding a stronger hedonic response on four sources of stimulation (emotions, senses, imagination, and intellect) [18], for both current and new audiences.

After discussing related work on the needs of different classical music audience segments, we outline the user-centered design approach that was taken. Subsequently, we present the results with respect to the first steps in our approach: the user requirements elicitation process that was preceded by the construction of user stories [16]. User requirements are derived from focus groups that address motivators and obstacles for classical concert attendance and that collect feedback on a set of user stories, containing ideas for the use of (MIR) technology to enrich the classical concert experience before, during and after the concert.

2. AUDIENCE SEGMENTS

While the classical concert audience sometimes perceives itself as homogeneous, in fact this is not the case [17]. To develop applications that support the needs of the classical concert audience, it is therefore important to distinguish different audience segments. Roose [19] suggests a tripartite audience segmentation. First, *passers-by* are incidental – typically younger - visitors that are not motivated by the concert performance itself, but rather by extrinsic motivations such as an evening out with friends. *Participants* comprise the core of the audience, consisting of well-informed, well-interested people that generally are not formally trained in music. In contrast, the *inner circle* consists of audience members that are professionally involved in the arts who frequently attend concerts and form a peer group for the performers. A large-scale survey conducted by [19] demonstrated that the average age for all participants was between almost 55 and 57. The educational level for all segments is higher than for the general population (above bachelor level or higher). Inner circle members are better educated than participants, who in turn are better educated than passers-by. This tripartite segmentation is used as the basis for the audience segmentation that will be used in this paper as the basis for application development.

3. MOTIVATORS AND OBSTACLES

The development of concert experience enrichment applications requires a solid understanding of why people enjoy classical concerts (*motivators*) and what *obstacles* they experience towards concert attendance. This section discusses existing literature on these, with focus on North-American and European audiences.[1]

In a Flemish study, Roose [19] distinguishes between extrinsic and intrinsic motivations for concert attendance and five classes of aesthetic dispositions. Even though the definitions of and relationships between motivations and dispositions are not precisely defined, they can shed light on why classical concerts appeal to different audiences.

Intrinsic and extrinsic motivators. Intrinsic motivations include the performers (e.g. a soloist or an orchestra), the programming, or a concert being part of a seasonal ticket. Extrinsic motivators are social motivators (advice from others, invitation from others, or spending time with friends), or attention in the media. Radbourne et al. [18] further elaborate on the social part of the experience, referred to as 'collective engagement'. They argue that this an important determinant of the audience experience. Collective engagement can take three forms: between the audience and the performers, among audience members, and between attendees and non-attendees. Social interactions stimulate discussion about the music [18], which would facilitate learning. This in turn would improve the audience experience.

Aesthetic dispositions. [19] distinguishes five aesthetic dispositions that influence one's inclination to attend classical concerts: emotional, escapist (e.g. change of setting to escape everyday concerns), familiarity (e.g. music one is familiar with), normative (e.g criticize society), and innovative (e.g. experiments with the tonal system, complex rhythmic patterns, etc., with the purpose of encouraging the listener to discover new meanings in the music). The innovative disposition primarily is particularly present in well-educated, experienced audiences.

In comparison to motivators for classical concert attendance, relatively little is known about the obstacles preventing people from attending classical concerts. [11] and [4] invited participants to attend a classical concert for the first time. Responses of first-time classical concert attendees can shed light on the preconceptions with which they enter the concert hall, and the difficulties they face. From these studies three classes of obstacles can be derived: limited sense of belonging, knowledge about classical music, and richness of the experience.

Limited sense of belonging. Classical concert novices might feel overwhelmed when they enter a concert hall for the first time due to the social conventions, the etiquette, and the social interactions that occur. [4] and [11] have shown that first-time attendees have trouble with adjusting to these. [4] reported a lack of a sense of belonging as a result of age differences and differences in clothing. The limited sense of belonging because of social distance and the unknown social conventions is amplified by a limited understanding of the music. Additionally, [11] found that the lack of interaction between audience members and between the audience and performers negatively impacted the experience of first-time concert attendees, corroborating the importance of collective engagement that was suggested by [18].

Knowledge about classical music. Respondents in [4] and [11] articulated the importance of acquiring a certain level of knowledge to enjoy the concerts more. Knowledge about classical music is also related to emotions. While the emotional response is an important determinant of the audience experience [18], these emotions

[1] To the best of our knowledge, no cross-cultural comparisons involving audiences with other cultural backgrounds have been made; however, also in this paper, we will focus on Western audience.

are more likely to be evoked when the attendee has a certain level of knowledge. Currently available information sources prove to be ill-adjusted to non-regular audiences, imposing an obstacle to the learning process. Respondents in [4] complained about the program notes, which were ill-adjusted to first-time attendees in terms of vocabulary and required general background knowledge.

Richness of the experience. Classical concerts are rather different for first-time attendees compared to popular music concerts. Kolb [11] indicated that their respondents were able to pay attention during about 10 minutes per piece. They also felt that there were little opportunities for interaction between the audience and the performers, while the setting did not allow for interaction between audience members. Participants in [11] indicated that the lack of visual stimuli on the stage caused the time to go slow. Participants in both [11] and [4] reported a lack of visual stimuli, caused by both the stage set up, and the way the performers dress (referred to as 'funeral attire').

To the best of our knowledge, no prior academic studies exist which comprehensively address both motivators and obstacles on classical concert attendance for multiple audience segments. In the following sections, we will describe how we investigated this, with the ultimate goal of developing innovative classical concert applications.

4. DESIGN APPROACH

The development of applications that are well-aligned with the needs and preferences of the users requires a multi-stakeholder approach. *Orchestras* characterize their target audiences through marketing research. New applications need to be aligned with their business model and their marketing strategy. *Existing and new audience members* need to provide input on their needs and expectations. Throughout the development cycle, they provide feedback on prototypes of increasing fidelity. *Technology providers* (businesses and research institutes) develop the actual applications, based on academic or business ambitions, balancing technology-push with technology-pull.

In **Figure 1**, a high-level user-centered design and development process for classical concert applications is displayed, involving the aforementioned stakeholders.

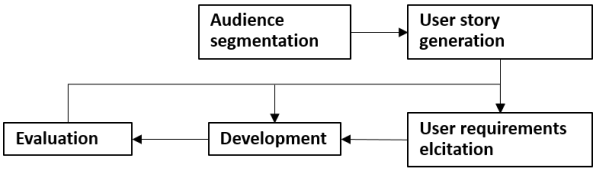

Figure 1 User-centered development process

Audience segmentation. In the work described in this paper, applications need to be tested for all parts of the concert experience: before, during, and after a concert. Based on (unpublished) marketing research from a Dutch orchestra, three audience segments were targeted: outsiders, casual consumers, and heavy consumers. In comparison to [19], *outsiders* (OS) are comparable to the passers-by or the 'culturally-aware non-attenders'. The *casual consumers* (CC) are in between the participants and the passers-by. While they have serious interest in attending classical music, compared to participants, their concert attendance frequency is lower, as is their average age, musical knowledge level, and less natural engagement with classical music. *Heavy consumers* (HC) comprise both the inner circle and the participants.

User stories. User stories describe specific functionalities, written from the perspective of an end-user. They function as data collection probes [1] – artefacts "containing open-ended, provocative and oblique tasks to support early participant engagement responses with the design process" (p. 1077). In our work, eight user stories were constructed that each describe a set of features for smartphone or tablet applications, expected to enrich the concert experience before, during and after event attendance. The user stories – described in [16] – address the needs of all three relevant target audiences (OS, CC, HC), while at the same time, they build on opportunities from the technological and MIR domain.

The insights gained from feedback on the user stories shape the *user requirements* in a way we will describe in the remainder of this paper. In their turn, the requirements form the basis for the iterative development and evaluation of these apps.

5. USER REQUIREMENTS ELICITATION METHODOLOGY

5.1 General approach

For user requirements elicitation, five focus groups were held: two in the Netherlands (one for HC consumers, one for CC consumers) and three in Austria (targeting HC, CC and OS consumes, respectively). After signing informed consent forms a project introduction was given. Participants then introduced themselves, focusing on their music preferences. Subsequently, motivators and obstacles for attending classical concerts were discussed, introduced by the questions "What makes a classical concert such a unique experience for you?" and "What prevents you from going to classical concerts more often"?, respectively. Afterwards, participants received a booklet with the user stories, which the participants read, annotated on sticky notes, and discussed. The focus group was concluded with a questionnaire, addressing technology use, music and concert behavior, and demographics.

5.2 Participants

In the Netherlands, participants were recruited via a mailing of the Royal Dutch Concertgebouw Orchestra's customer association, whose members fitted our CC and HC criteria. In Austria, a recruitment e-mail was sent to all students of a university. A sign-up form with questions about classical music involvement was used to divide participants over the three audience segments. **Table 1** reports participant characteristics for all focus groups.

5.3 Data analysis

After transcription, the data were analyzed using thematic analysis, a form of pattern recognition within the data, where emerging themes become analysis categories [8]. Data were analyzed with the purpose of identifying moti-

vators and obstacles for concert attendance. Feedback on the user stories was analyzed with the purpose of deriving opportunities for applications to enrich the classical concert experience. Note that even though the differences between the Netherlands and Austria are of interest to the goal of our study, other differences between the samples (e.g. age, occupational status, income, experience) prevent us from doing a valid cross-cultural comparison.

Measure	The Netherlands	
	CC	HC
N	6	13
Age	27.7 (.8)	54.7 (15.2)
Concert attendance		
> once/ month	1	5
once/month		
once/quarter	4	8
once/year	1	

Measure	Austria		
	OS	CC	HC
N	7	10	4
Age	29.4 (8.2)	27.8 (11.3)	27.5 (3.8)
Concert attendance			
> once/month		1	
once a month			1
once/quarter	3	3	2
once every year	4	6	1

Table 1. Focus group participant characteristics

6. MOTIVATORS AND OBSTACLES

In this section, we present the results of devising general motivators and obstacles from the user requirements elicitation process. Transcription, analysis, and coding of the results has led to the definition of 17 motivators and 16 obstacles, of which we will discuss the most important ones, backed with statements from the discussions. Statement quotes use the following abbreviations: #n=participant ID; OS=outsiders, CC=casual consumers, HC=heavy consumers; NL=the Netherlands, AT=Austria. Statements from sticky notes do not have a participant ID, as they were collected all at once on a flip-over sheet.

6.1 Intrinsic motivators

Concert experience and musical quality. Across target groups, participants appreciate the uniqueness of the concert as a one-time event during which high-quality music is played. Participants clearly see the added value of a live concert in comparison to a recording. They felt that this was not only applicable to classical music, but also to concerts in other genres (CC-NL, OS/CC/HC-AT).

The discussions revealed that in classical concerts, attendees are motivated by the interaction between the conductor and the orchestra, between the audience and the performers, and by the orchestra members themselves. Tension and suspense fascinated the participants: "You can see tension with musicians, feeling is transmitted through the way they look and move. You can also see this from the conductor. (…) you can feel the emotion, not just audio. You don't get this in a recording." (#9-CC-AT). From the OS-AT group it became apparent that this fascination not only applies to classical concerts, but also to other genres.

Escapism. For casual consumers and heavy consumers in both AT and NL, escapism – an aesthetic disposition mentioned by [19] – is an important motivator for classical concert attendance. Participants indicated that submerging themselves in an environment in which they cannot do anything else but focus on the music allows them to disconnect from their daily concerns ("At a classical concert I forget all my problems, I am not stressed, #6-CC-AT). In that sense, a classical concert was compared to a church service: "A moment to be quiet" (#2-CC-NL). Another participant emphasized the difference to listening to classical music at home: "It's an obligation to listen to a concert in peace and quiet. I don't succeed in doing that at home" (#5-CC-NL).

Need for cognition. People differ in the extent to which they desire to engage in cognitively effortful activities [2]. In the CC-NL and HC-NL groups, opportunities for cognitive engagement and learning motivated several participants to attend classical concerts. Curiosity about the musicians, the piece, and the performers was expressed (referred to as 'hunger for information'; #5-CC-NL). However, this need for cognition and learning was not expressed by participants in the outsider group.

One participant in the CC-AT group connected the escapist motivator and the resulting focus on the music to an increased level of processing: "You start thinking about things. You discover new pieces". Another participant noticed a difference in attitude with respect to learning: "Awareness and qualitative enjoyment of a piece is more important than entering the hall snobbishly, pretending that you know everything" (#5-CC-NL).

6.2 Extrinsic motivators

Social influences. Participants reported that having peers or family members with the same interests, helps to get motivated for classical concerts. One participant commented: "I notice that it works well when you know a couple of people in the orchestra. It makes things more personal. And lowers the barrier to join in" (#6-CC-NL). Furthermore, in particular the younger CC-NL group preferred a concert experience to encompass more than just the performance itself (e.g. appreciating "A drink at a bar with young people afterwards"; #5-CC-NL).

6.3 Intrinsic obstacles

Importance of classical music. The discussions revealed substantial differences between audience segments concerning the role classical music plays in people's lives. Consistent with findings from [19] and [11], we found that participants are not exclusively focused on classical music, but are 'culturally mobile' [7]. One participant explained: "You just don't visit 10 classical concerts. There is more than classical music. It's interesting if something comes up. And that's what our generation likes" (#3-CC-NL). Participants also mentioned that their interest in classical concerts is mood-dependent.

Preparation and risk. Substantial differences were found with respect to the effort audience segments were

willing to invest in concert preparations. While the CC-NL group requested easily consumable information, the HC-NL group was motivated to invest more time ("I can spend hours on YouTube watching videos about what a singer has done before"; HC-NL), and considered preparation as part of the pre-concert anticipation. The discussion in the OS-AT group revealed that the risk of buying an expensive ticket can be too high ("It's expensive for just something you don't know", #4-HC-AT). To reduce this risk, participants felt they needed to invest time in finding information about the performers and the piece. This factor was more important in AT than NL, probably because due to the AT participants being students.

Concert setting and conventions. Consistent with [11] participants in the younger groups (OS/CC-AT; CC-NL) felt disconnected from other concert attendees, primarily as a function of the age difference "What stops me? That there are very, very, very many seniors in the hall. Sometimes that disturbs me" (#2/3/5, CC, NL). Participants also mentioned the complexity of concert conventions for novices ("a classical concert can be intimidating. Unknown. They don't know the rules", #4+6-CC-NL).

Richness of the experience. Results suggested that the perceived richness of the experience was dependent on both the age group and the level of engagement with classical music. Younger groups (CC-NL, OS-AT, HC-AT) noted that "The experience is richer in other genres, for classical it's more about the music itself" (#3-HC-AT). One participant (#3) in the OS-AT group commented on the lack of surprises, knowing already what the playlist is. Interestingly, the HC-NL group considered the surprise element to be a motivator ("At every performance you become surprised by something…you hear things you won't hear elsewhere", #10-HC-NL). Outsiders (OS-AT) and casual consumers (CC-NL, CC-AT) commented on the lack of opportunities for physical expression. "I miss standing up. Being engrossed in music you also experience physically." (#2-CC-NL). This radically differs from their experience with non-classical concerts.

6.4 Extrinsic obstacles

Social influences. Younger participants – most present in the OS and CC groups – indicated that their peers were less interested in classical music, causing a lack of company. This prevents the respondents from going more often, both in Austria and in the Netherlands. (#3-CC-NL, "You have to know people that also like classical music"; #9-CC-AT, "It's easier to find friends who want to join me to a rock concert". Other extrinsic obstacles included ticket costs, and the long time attendees needed to plan ahead when they want to attend a concert.

7. APPLICATION AND MIR OPPORTUNITIES

In this section, we aggregate user story feedback under several clustered themes. We discuss relevant feedback per theme, formulate exemplary requirements for technology-supported concert applications, and discuss integration opportunities for MIR technology.

7.1 Support with preparation

The discussion on motivators and obstacles has highlighted the importance of concert preparation across expertise levels. User stories facilitating concert preparation were well-received. The CC groups appreciated the convenience of having information in one place ("We are part of a generation that is used to large amounts of information, but also to get it presented in an easy way"; #2-CC-NL). Both the HC-NL and the CC-NL group appreciated the added value of the information, particularly historic context, for preparation before the concert, but also for better understanding during and after the concert.

When working towards concrete applications, this leads to the requirement that the applications should *offer information about the composer, the musicians, the piece, and its historical context*. MIR technology can support this by developing cross-modal and cross-performance synchronization methods, and techniques for analyzing and combining hybrid music information resources.

7.2 Need for support to understand the music.

While participants wanted to avoid overemphasizing cognitive aspects, across groups a need was expressed for understanding the music, learning about what parts one should pay attention to, and discovering unexpected new elements. Participants recognized the difficulty for novice listeners to understand and then enjoy the music "because music is hard to grasp/decipher" (CC-NL). They expressed interest in the structure of the music, the composer's intention, the conductor's interpretation, and the discovery of style differences in comparison to recordings. User stories that provide this support were assessed positively, in terms of their educational potential and the potential to lower the barriers for outsiders to start attending classical concerts.

In terms of application requirements, two main requirements can be extracted: the applications should *offer representations of the musical structure* and *the user's attention should be attracted to parts of the music which wouldn't have been noticed otherwise*. These interests confirm the relevance of MIR work on automated music description, performance analysis, and visualization.

7.3 Audience expansion by sharing relevant moments

The user stories included application features allowing users to annotate particularly interesting moments, to review the notes and related audiovisual content after the concert, and to share notes and their corresponding fragments through social media. Participants felt that the sharing of small fragments could function as an "'opener' for people unacquainted with this type of music" (HC-NL). By sharing the experience, users can motivate their friends to attend a classical concert ("if you share this, you can tag someone along"; CC-NL).

While the opportunity to review and share particularly interesting moments *after* the concert was generally evaluated positively, taking notes *during* a concert was perceived as distracting. Participants were concerned with the impact on the concert experience ("It's not a lecture"; HC-NL). They felt that the cognitive effort of taking notes "destroys magic of non-repeatable live experience".

A one-button marker was frequently mentioned as a lightweight solution: ("Annotations for a specific moments, ok, but not with text, only with a marker. Which means: I want to hear this again"; CC-NL).

This leads to several application requirements: applications should *enable the user to set a marker at a particular moment during the concert by pressing a single button* and *enable the user to listen to marked fragments after a concert*. While the concepts of marking, annotating and sharing are somewhat related to work on social media and autotagging in the MIR community, many open questions are raised regarding temporal aspects of 'interesting moments', and especially the type of information to be displayed and marked.

7.4 Personalization and control

The results revealed substantial differences between and within audience segments, concerning their expectations of the concert experience, attitude towards technology, and level of classical music experience. Considering these differences, participants expressed interest in personalized information. Here, 'personalization' had two meanings: first, participants preferred to only receive information that is relevant to them, notwithstanding their need for a certain level of surprise in the information offered. Second, they wanted to switch on and off different layers of information to personalize their user experience.

These notions lead to two corresponding requirements formulations for applications: *the user must be able to receive personalized content by filling out a limited number of questions* and *the user must have control over the layers of information that are displayed*. Regarding the first point, an explicit questionnaire is suggested, as this provides both most transparency to a user, and avoids data sparsity issues. Still, it is useful to assess the potential of automated MIR profiling and recommendation techniques, in terms of usefulness and feasibility.

7.5 Caveat: interference with the concert experience.

One important caveat was brought up in every focus group: applications should refrain from interfering with the live concert experience. Participants wanted to enjoy the music without engaging in cognitive activities. This is in line with the escapism disposition from [19], which also emerged from the focus groups as a motivator. In terms of [18], an overemphasis on cognitive stimulation potentially prevents sensory or emotional stimuli from contributing to the concert experience. ("How can you combine a tablet with emotions?" HC-NL).

When tablets were discussed as a possible medium in concert halls, participants were worried about distraction by messages about everyday affairs ("You might receive a work-related e-mail that makes you tense up", CC-NL). Second, tablets might also distract other audience members due to the light emittance of tablets in an otherwise (semi-)dark concert hall. The strongest rejection of these ideas came from the participants in the HC-NL group who wanted to keep the concert experience as it is.

This leads to a very clear and strong requirement that applications *must not distract the user or other concertgoers while listening to a live concert*. In terms of MIR technology, this poses open challenges with respect to user experience design of in-concert applications.

8. CONCLUSIONS

In this paper we discussed a user-centered design approach to identify opportunities for technological enrichment of the classical concert experience. Departing from a tripartite audience segmentation and common motivators and obstacles for concert attendance from literature, five focus groups were conducted in which these motivators and obstacles were further refined and connected to application and MIR technology inclusion opportunities.

A trade-off was found between offering cognitive support to users and allowing users to enjoy the concert without disturbance. Light emittance, required attention by the user, and the impact on other concertgoers are the most important concerns that were voiced by the participants. In contrast, stronger support was found for ideas that improve the understanding of the music. Participants also supported ideas to relive marked interesting moments of the concert, although the marking effort during the concert should be limited to pressing a single button.

The reported results support our plea for a detailed assessment of end-user needs and user characteristics. Our results reveal differences between individual participants with respect to their aesthetic dispositions [19], cultural mobility [7], and also the type of stimulation participants expect from a concert [18]. Furthermore, consistent with [21], the results suggest that age affects user acceptance of technology in the concert hall – with older participant being more reluctant towards changes of the concert experience. In sum, the results emphasize that what is a motivator for one attendee, can be an obstacle for another.

Classical concert applications for such a heterogeneous audience require a personalized user experience, with many opportunities to integrate advances from the MIR research agenda. At the same time, the success of resulting applications will depend on their connection to end-user needs and expectations. The chosen *presentation and contextualization of information* is a critical factor in this, which is not yet thoroughly examined with true end-user involvement in MIR.

Follow-up steps in our approach are to iteratively design and evaluate application wireframes for prototypical applications, while simultaneously developing the backend (MIR) technology. Results of consecutive evaluations will then refine and extend the requirements and opportunities presented in this paper.

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