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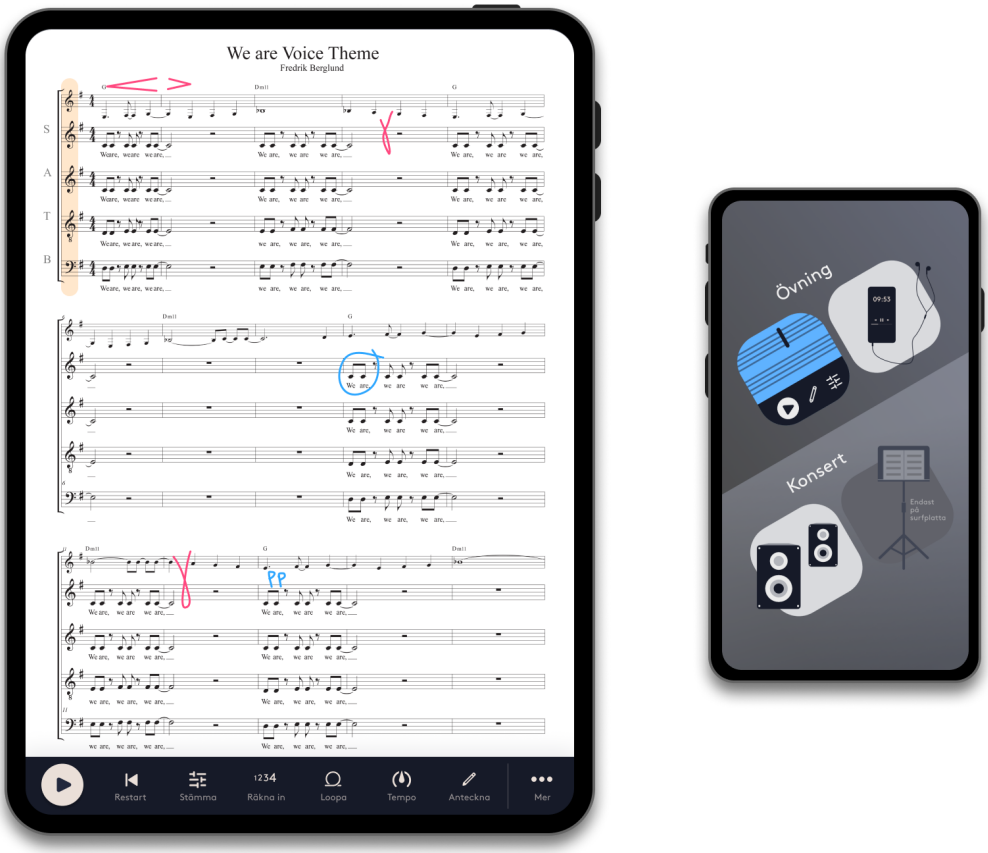

Designing a Digital Tool for Singing

Improving the UX design for a choir and solo singing app in collaboration with We Are Voice

Master's thesis in Industrial Design Engineering

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DIVISION OF DESIGN AND HUMAN FACTORS

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Gothenburg, Sweden 2021
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Master of Science Thesis

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Thanks to We Are Voice, who welcomed me with open arms. Since I am passionate about music and singing, it has meant a lot to me to have had the chance to develop a digital tool for this purpose. Thanks to CEO Martin, and my company supervisors Fredrik and Kalle, I have learned so much from you in such a short time. Thank you, Katarina, Johan and Patrik who, from the very first moment, made me feel welcomed.

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Last but not least, many thanks to the participants in the user studies. I cannot alone take credit for the results of this work - it was a co-creation effort, and it simply would not have been possible without you.

Miriam Napadow, Stockholm, September 2021

ABSTRACT

This thesis work was conducted in collaboration with We Are Voice with the aim of improving the user experience of their current digital tool for singing rehearsal. The tool was an app running on phone and tablet, providing the users with sheet music and recordings with separate tracks for each part of the piece (e.g., one track for soprano, another for alto, etc.).

The objectives were to gain user insights through user studies and to make a design proposal based on the users' input. The focus of the project was to develop the media players of the app, investigate if it could be used for both choir and solo singing, as well as in all important situations (individual practice, joint rehearsal, and concert).

The studies consisted of a market analysis, an ensemble user study, as well as a user survey. The ensemble study, which was the most comprehensive study, used a combination of several methods, such as enactment, digital diary, focus group, and co-creation. The results were analyzed using a KJ-analysis and the user needs were summarized. Based on these needs, an ideation phase took place through brainstorming, and solutions for each user need were generated. This phase resulted in three contrasting concepts of low fidelity.

After discussions and feedback from We Are Voice, a final concept of medium-high fidelity was developed in the software Figma. In this final concept, four different modes were suggested in order to cover all users and situation-based needs. The first two were practicing modes (*Sheet Music & Audio* and *Learning on the Go*). The last two were concert modes (*Backing Track* and *Sheet Music*).

The conclusion of this thesis study is that an app that aims to satisfy the users' needs, must provide (1) the *same* important functions as paper sheet music (a substitute that works for both joint rehearsal, individual practice, and concerts), as well as provide (2) a *higher* value than paper sheet music. The most positive outcome of the presented design proposal is that it works for *all* important situations and users, achieving both (1) and (2).

Keywords: Design for User Experience, Product Development, App, Activity Theory, Singing, Music.

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1. Introduction

1.1 BACKGROUND

Choir and solo singing

Choir singing is an activity performed by both professionals as well as at a hobby level. In Sweden, choir singing is a relatively popular activity, and in 2019 the Swedish Choir Association had approximately 600,000 members (Sveriges Körförbund, 2019), and European Choral Association (European Choral Association, 2015) estimated that 37 million Europeans were choir singers in 2015. For amateurs, it is common to meet their choir once a week to practice together for 1-2 hours. Choir singing is for many not only a musical activity, but also a social one. It is common for the choir members to organize themselves and distribute responsibilities regarding concert activities, economy, trips, etc. Between the joint rehearsals, the choir singers are usually expected to practice individually at home. Most choirs have a conductor who helps them with rehearsal, conducting, and accompaniment. A large part of choral music is a cappella, that is, music consisting of only voices, without instrumental accompaniment. A choir usually consists of several parts (e.g., soprano, alto, tenor, bass), and there are several different voicings, for example SATB or SSAA.

Solo singing is also an activity performed at both professional and hobby level, and differs somewhat in the practice from choir singing, although the two activities naturally share several common features. Some solo singers are self-taught, while others take lessons from a vocal teacher, or may even have a formal music education. Most often, the solo singer wants some type of accompaniment, which can either be provided by an accompanist (e.g., pianist, guitarist, instrumental ensemble) or a backing track (recorded background). The most significant difference between choir and solo singing is that a soloist who performs with a background or accompanist and usually has no conductor and has to adapt to the accompaniment rather than other choir parts.

For both choir and solo singing, there are large variations in practice. Some use sheet music, others do not, depending on both traditions of the genre and levels of proficiency. Both choir and solo singing occurs all genres, from classical repertoire to pop / rock / jazz. Each tradition has its own practice at concerts, singing technique, relation to sheet music and terminology.

We Are Voice

We Are Voice is a company based in Stockholm, Sweden, which started in 2016. Their mission is to digitize the choir movement and provide its users with a digital rehearsal tool for singers, as well as providing fair compensation for arrangers and musicians who contribute with musical content to the app.

We Are Voice's current app

Until now, We Are Voice's main target group has been choir singers in all genres, and at the time of writing, the company has just started to investigate whether the app could also be used for solo singing.

The app has a large music library including approximately 1000 pieces of music in various voicings and genres. A large proportion of these pieces include recordings, with separate tracks for each individual part. We Are Voice has a media player that plays the piece while at same time displaying a synchronized cursor moving over the sheet music. This serves as a pedagogical tool for those choir singers who want to practice individually but may not be able to read sheet music fluently. At present, the appearance of the media player differs slightly depending on which format the piece has been delivered to We Are Voice. Some pieces have sheet music only for instance, while others have sheet music with synchronized recordings. In some of the pieces that includes recordings, the exact volume of each part could be adjusted in a mixer, while it in other pieces is only possible to listen to one part at a time.

Common to all pieces using synchronized sheet music and recordings, are the features *Play / Pause* (Figure 1), *Mixer* (Figure 1), *Tempo* (Figure 2), *Loop* (Figure 2), option of *Horizontal* (Figure 3) or *Vertical Page Orientation* (Figure 4), and *Zoom* (Figure 4). In the top left corner, there is an option leading back to a playlist menu.

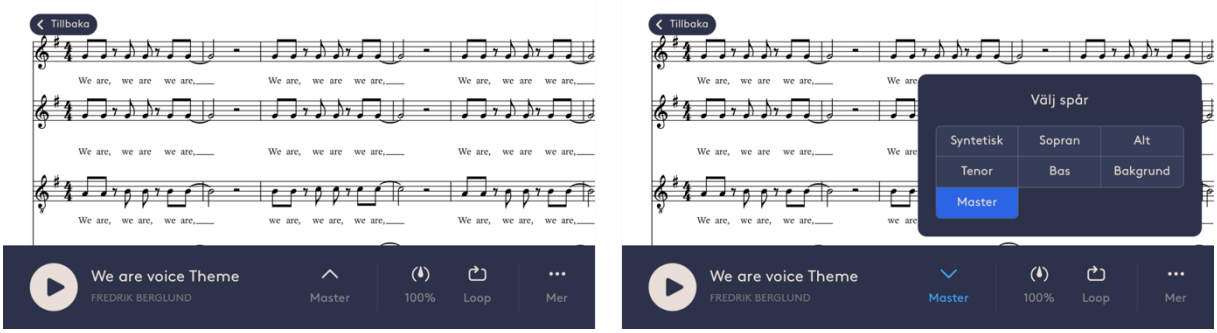


Figure 1. Media player and menu (left), and option to listen to the pieces' individual parts (right).

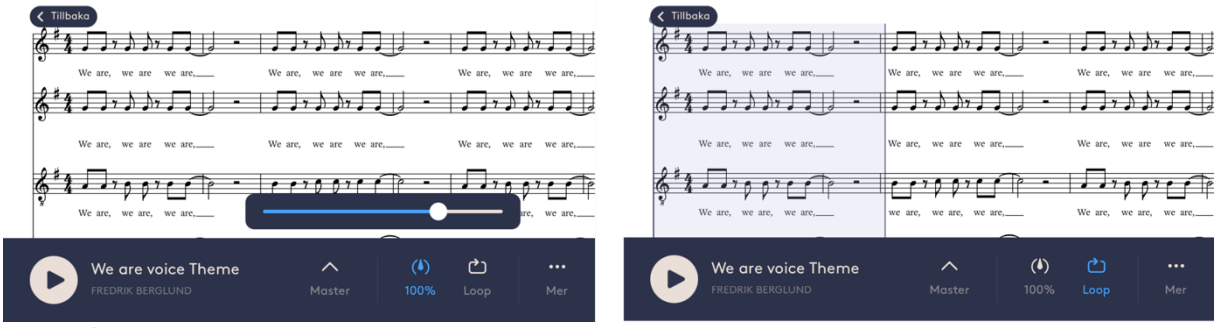


Figure 2. Tempo slider (left), and Loop option (right).

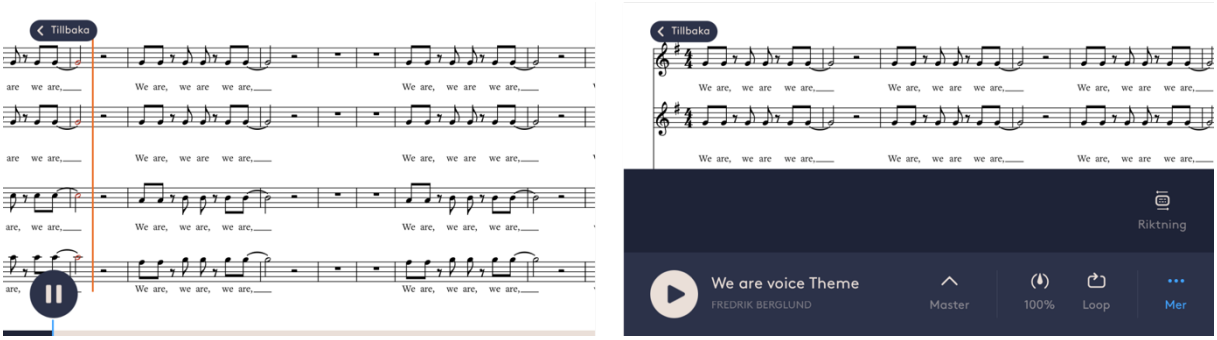


Figure 3. Horizontal Page Orientation when player is running (left), and option to change to Vertical Page Orientation, "Riktning" (right).

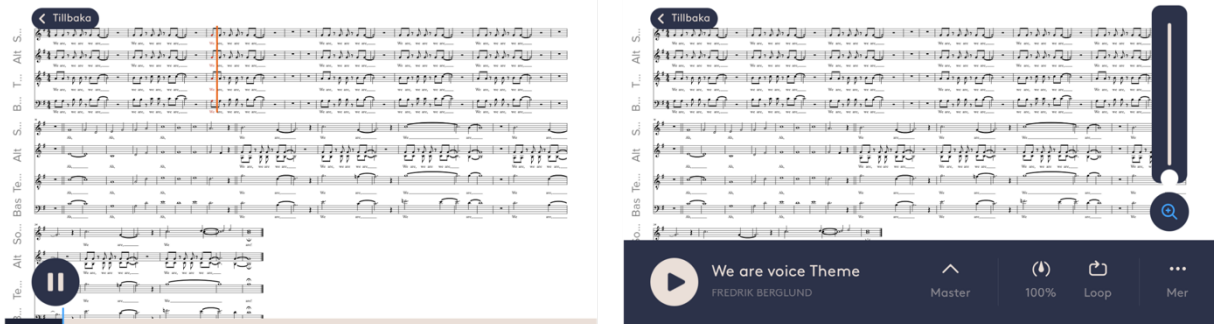


Figure 4. Vertical Page Orientation when player is running (left), and Zoom option (right).

The app is a subscription service with the three levels *Free* (the features are locked, but the user can see which features are available), *Premium* (SEK 49 / month and the user gets access to the entire music catalog) and *Member* (SEK 19 / month, the user only gets access to playlists created by the group administrator, usually the conductor). In addition to the music catalog, the app works as a communication platform for the choir, where members can communicate by writing posts, creating playlists, joining groups, and getting tips on other playlists (Figure 5). The app runs on both tablet and phone, in both Android and iOS. During the project, a version for browsers (laptop) was also launched.

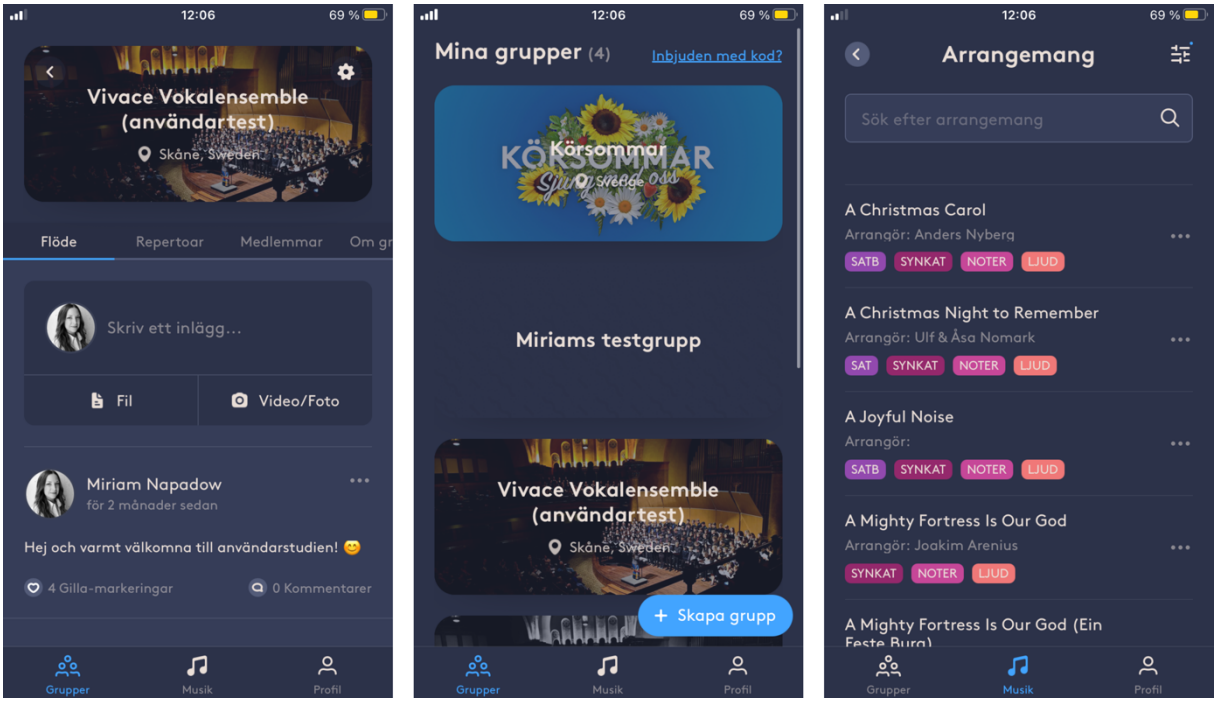


Figure 5. Social platform for groups (left and middle), and music catalog (right).

Activity Theory

Activity Theory applied to interaction design (Kaptelinin & Nardi, 2006) is a theoretical framework (Figure 6) for understanding how a user (*subject*) uses a tool (*mediating tool*) to achieve a goal (*object*). Furthermore, the activity always takes place in a context. Activity Theory can be used as support in the user research process to gain important insights.

Since choir and solo singing are complex activities, Activity Theory will be used as a guide to understand them from a holistic perspective. Building an app for singing means that users interact with the app not only by tapping on the screen, but also by reading on the screen in tempo with the music, while at the same time singing and listening to themselves together with the recordings. The singers also interact with each other (listen to the intonation) and try to have eye contact with the conductor and audience.

In this project, the *subject* refers to the choir singer, solo singer, conductor, and accompanist. Using the *mediating tool* (could be sheet music, recordings, instruments, or the We Are Voice App) they strive to achieve the *object*, namely, to be able to perform a musical piece (with or without audience). In this thesis project, these components are assumed to form the core of the activities solo and choir singing, although there may be other important objectives and motivations for practicing singing. The context in this case will be, for example, the audience (which should also be considered as a type of extended user), practice in different genres and levels of proficiency, and practice in different situations (*individual practice, joint rehearsal,* and *concert*).

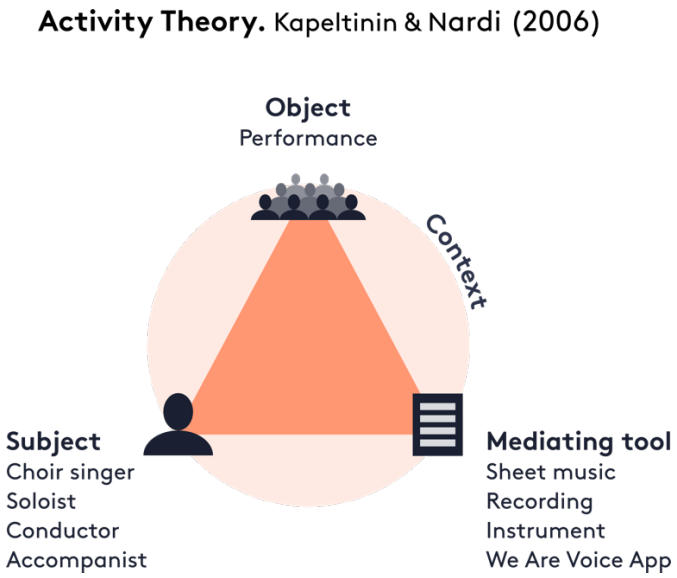


Figure 6. Activity Theory applied on choir and solo singing.

1.2 HUMAN-CENTERED DESIGN

This thesis work will build upon a *human-centered design* approach. Human-centered design means, as the name suggests, starting from the human user's needs, and through a creative process generate innovative solutions to problems that improve people's lives (DesignKit, 2021). *Designing for user experience* is also a key aspect of this project, as user experience concerns how the user feel about the overall impression and satisfaction from using it (Sharp, Rogers & Preece, 2019). Furthermore, the design process in this thesis is characterized by *design thinking* (IDEO, 2021), which does not have only one definition, but is rather an approach or strategy for problem solving. The Design Thinking process consists of the five steps *empathize, define, ideate, prototype,* and *test* (Interaction Design Foundation, 2021), which will be used as a guide throughout the project. Most, if not all, design problems are so-called *wicked problems* (Buchanan, 1992). This means, that finding the correct definition of the problem is as much a part of the solution as the solution itself. The designer must therefore be guided by curiosity and openness towards the users, as well as be ready to reconsider prior assumptions.

1.3 THESIS PROJECT

Aim and Objective

The aim of this thesis project is to improve the users' experience of We Are Voice's app. The output from this work is supposed to benefit We Are Voice in its future product development work and provide them with insights of their users, as well as providing them with a basis for future strategic design decisions. The purpose is to design a service that satisfies the users' needs in the form of a digital singing practice tool.

The main objectives of this thesis work are to:

- Gain and communicate insights about current and potential users, as well as the context in which the product operates, by conducting user studies.

- Make a design proposal by the media player that improves the user experience, satisfaction, and usability, within a solution space that could be implemented given We Are Voice's current resources.

Demarcation

Music reading ability varies greatly between choirs; many singers possess music reading ability to some extent, but sometimes they also need to listen to the music to learn it. Professional, fluently music reading singers differ from amateurs in this aspect, and do not need to practice with a recording. Since We Are Voice's main product consists of providing users with recordings together with sheet music, fluently music reading singers are not the main target group and will therefore not be addressed. However, most choirs often have professional elements, and these can be included in the user studies. The conductor is usually educated at a music conservatory, and it is not uncommon for some choir singers to be highly skilled music readers or perhaps even have studied music at a higher educational level.

The branding and graphic profile (fonts, colors, form, etc.) was already developed by We Are Voice and their partners. In this project, therefore, no elements of the graphic profile were further developed. Instead, the existing graphic profile was applied to the design proposal, so that We Are Voice could easily implement the presented design solutions.

Only the user experience of the *media player* (and aspects related to it) was examined in this master thesis project. Other parts of the app, such as payment flows or the social platform, was not directly addressed in this work.

Furthermore, the pandemic with Covid-19 imposed certain restrictions on the execution of user studies. The studies had to be carried out in a safe manner, and for this reason there were ethical and safety reasons for conducting user research remotely that preferably should have been done on site. It also entailed a restriction regarding what sample to recruit for physical user studies. For instance, only young and healthy participants were recruited, even though singing is an activity performed by many older people and which potentially has other needs regarding technical skills, readability, and preferences.

Ethics

The Covid-19 pandemic means that special ethical aspects had to be considered when conducting the physical user studies. All user studies were performed in accordance with the Swedish authorities' recommendations (Folkhälsomyndigheten, 2021), and as a further measure, only young (aged 20-30) and healthy participants were recruited for the physical user studies.

All participants gave their expressed consent to voluntarily participate in the study, and all data was anonymized. Data was collected in accordance with the GDPR. One part of the user study included a digital diary, and the users were given the option to choose whether they wanted to share their input through a non-public social media account, or some other, more anonymous communication channel (whereupon all

chose the non-public social media account). The character of the project overall, choir singing, was not considered to generate any sensitive information or situations. On the contrary, singing is for most people an enjoyable and recreational activity.

There were also ethical and legal aspects concerning music copyright that was considered during the project.

Regarding ecological footprint and sustainability aspects, digital sheet music might be a better alternative than printed. Studies have shown that certain types of e-books have lower ecological footprint compared to printed books (Tahara, Shimizu, Nakazawa, Nakamura, & Yamagishi, 2018). It is not confirmed, however, that the use of digital sheet music is comparable to, for example, e-books, but measuring the exact usage and corresponding emissions reaches beyond the scope of this thesis.

Disposition of Thesis

Followed by this *Introduction*, a *Method* section will be presented. After this, a *Market Analysis*, results from *two user* studies (*Ensemble User study* + *User Survey*) as well as a *Synthesis of User Studies* will be presented. Finally, the sections *Ideation*, the *Design Concept,* and *Discussion and Conclusion* will be presented.

The design process (Figure 7) in this project was initiated by a phase of *User Studies* and *Market analysis* (i.e., three parallel studies), followed by *Analysis*, *Ideation*, *Evaluation* and ended with the final *Design Concept*. For full project time plan (Gantt chart), see Appendix 1.

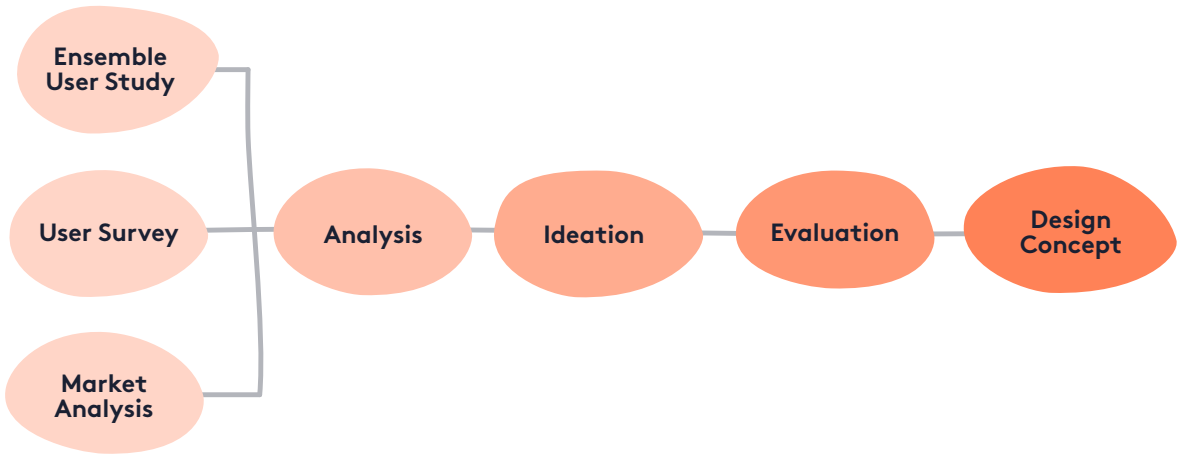


Figure 7. The design process of the thesis project.

2. Method

2.1 MARKET ANALYSIS

First, a user map of the target groups created, based on input from We Are Voice, to identify what other services and products should be considered competitors. This user map also included the contexts in which the service is intended to operate.

The market analysis included competing products found on the market. The purpose of the market analysis was to provide We Are Voice with important insights to make a strategic and clear market positioning. Clear positioning is crucial in order for users to understand why a service or product solves their particular user need (Jobber, Ellis-Chadwick, 2019). In addition to obvious competitors, the analysis also included related products (e.g., for other instruments or other customer segments) as well as substitute products. Potential future competitors were also explored, since the technology used in other product categories are likely to be used for singing apps in the future. A total of 20 competitors were included.

2.2 ENSEMBLE USER STUDY

The Ensemble User Study was the most comprehensive study in this thesis project. It involved a combination of several different qualitative methods. The participants were supposed to not have used the app previously, with the intention of understanding what new users need in order to be interested in the app. The participants consisted of a convenience sample that was recruited via social media. Most participants knew each other, which was believed to be positive since it had the potential of creating a relaxed atmosphere. The participants were compensated for their participation with a We Are Voice Premium subscription for 6 months.

Participants

The ensemble user study consisted of two ensembles, one located in Malmö, the other in Gothenburg. The author acted as a participating observer in both groups and performed the same singing tasks as the participants. This was done partly to (1) gain experience similar to the participants', and partly to (2) create a good atmosphere, where the participants would not feel scrutinized while singing. The ensemble in Malmö consisted of 5 participants (6 including the author) with relatively high musical proficiency (between 1-7 years of post-secondary music education). The ensemble in Gothenburg consisted of 2 participants (3 including the author) where the participants had choir experience, but had not attended any higher music education. One more participant had registered interest for the Gothenburg ensemble, but was unfortunately prevented due to illness. In the total sample, there was a large spread in music-reading ability; both non-music readers, intermediate level and advanced music readers participated. The sample consisted of women aged 20-30 years.

Procedure

Each group received instructions via a non-public social media account on how to download the app and create a Premium We Are Voice account. They were also informed that the study consisted of three parts: (1) *joint rehearsal*, (2) *individual practice*, and (3) *fictive concert + focus group + co-creation*. Before the first part started, participants were in a social media post asked to imagine a scenario, namely that they belonged to a choir that would perform three songs at a wedding. This scenario was intended to make the participants enact what it would be like using the app in real situations. The songs the participants were asked to learn were:

- *Goliat*. (L. Pourkarim, G. Thörn. Arranger: F. Berglund). Solo song, pop, containing accompanying background.
- *Tre Lå*. (Trad. Arranger: H. Kennemark). SSAA, classical, a cappella.
- *It's Raining Men*. (P Jabara, P Shaffer. Arranger: Å. Hagerman). SSAA, pop, containing accompaning background.

The first part of the study, (1) *joint rehearsal,* was a physical meeting where the ensemble met for about 1.5 hours. The participants themselves chose what part to sing, and then practiced the three pieces together. They were asked to learn the solo song (Goliat) as if they were to perform it as a solo singer. In the group from Malmö, one of the participants took on the role of conductor. In the Gothenburg ensemble, the conductor role was taken by the author. The meeting was recorded with both audio and video, which was then transcribed.

The second part of the study, (2) *individual practice,* took place during the week after the first meeting, and consisted of practicing individually and keeping a digital diary. This digital diary was kept over the same non-public social media account and consisted of scheduled questions and reminders that were sent once a day. Participants were encouraged to reflect on the experience of the app, and if necessary, send photos and screenshots. No meetings took place during this part of the study.

The third and final part of the study, (3) *fictive concert + focus group + co-creation*, consisted of an approximately 2h long physical meeting, one week after the first meeting. This was also recorded with both audio and video, which was then transcribed. The meeting began with the participants enacting a performance of the fictive wedding gig, singing the three songs. After the fictive wedding gig, the participants were asked to react to prepared statements and have a focus group discussion. These statements were written on small pieces of paper that lay in six different envelopes with the labels *"choir singers", "conductor", "choir audience", "soloist", "accompanist",* and *"soloist audience"*. The purpose of the different labels was for the participants to reflect on the perspectives of different users. One at a time, the participants drew a statement from one of the envelopes, decided whether they agreed or not, and then other participants were able to react and discuss. After this activity, the participants watched four videos where digital sheet music were presented in different ways (variations in color, animation, etc.). Simultaneously, they discussed and rated to what extent they liked or disliked the way the sheet music

was presented. The last part of the meeting consisted of a co-creation session, where the participants in pairs were encouraged to create their own app. Each pair was given a prepared A3 paper template where they could express themselves by drawing, writing, using post-its and stickers.

All comments from the ensemble user study (quotes from the meetings and the digital diary) were analyzed through a KJ analysis (Kawakita, 1967) and presented to stakeholders through the collaborative software Miro (2021). Using a KJ analysis, means all quotes were reviewed and then categorized into themes that was related to similar user needs. In the KJ analysis, a total of 25 different themes with associated requirements and attitudes were discovered. These themes are presented in the chapter *Ensemble User Study*, together with the authors interpretation of what was observed at the meetings.

2.3 USER SURVEY

A digital survey was sent by e-mail to all users with a registered We Are Voice account, with the purpose of collecting quantitative data about the current users and their needs. This method was chosen in order to complement the qualitative Ensemble User Study - the quantitative data was supposed to provide with an idea regarding the importance of various needs, in case priorities had to be made. A total of 91 people answered 21 questions about their use of the app in different situations and on different devices, their repertoire, attitudes, opinions on new features and more. The most relevant findings from the survey are presented in the chapter *User Survey*.

2.4 IDEATION

After conducting and analyzing the results from user studies and market analysis, the ideation phase began. First, solutions to each discovered user need were brainstormed through sketching. Because there were such a large amount of user needs, a brainstorming session was also needed to discover simplifications of the structure and flow of the media players (i.e., to meet all users' needs without overloading them with too many menu items).

Subsequently, three contrasting concepts of low fidelity were created, emphasizing three different user groups and corresponding needs, in order to create discussion and decision material for We Are Voice to take a stand on. These three concepts were created in the software Figma (2021) and Affinity (2021), and presented in the software Miro (2021). At this stage of the design process, only the functions and dimensions (due to limited screen size) were important, avoiding distracting topics of a too high level of detail, such as symbols, color choices and fonts.

2.5 EVALUATION

The evaluation of the three contrasting, low-fidelity concepts took place through discussion with We Are Voice. Prior to the creation of the final design concept, We Are Voice's future strategy and target groups were considered.

2.6 DESIGN CONCEPT

The final design concept prototype was made in Figma with medium-high fidelity (non-interactive prototype). We Are Voice's graphic profile (colors, fonts, etc.) was applied to the prototype. Furthermore, as far as possible, Google's (Google, 2021) and Apple's (Apple, 2021) guidelines were applied. Creative common icons for app design from Google (Google, 2021) was also used. Guidelines for gestures for mobiles and tablets concerning controls and dialogs (Cooper, Reimann, Cronin, & Noessel, 2014) were also applied.

3.Market analysis

3.1 USER MAP

Before starting the competitor analysis, a user map (Figure 8) was created. The different user groups were identified based on information from We Are Voice. Included in the user map was also the potential new users that We Are Voice were interested in attracting.

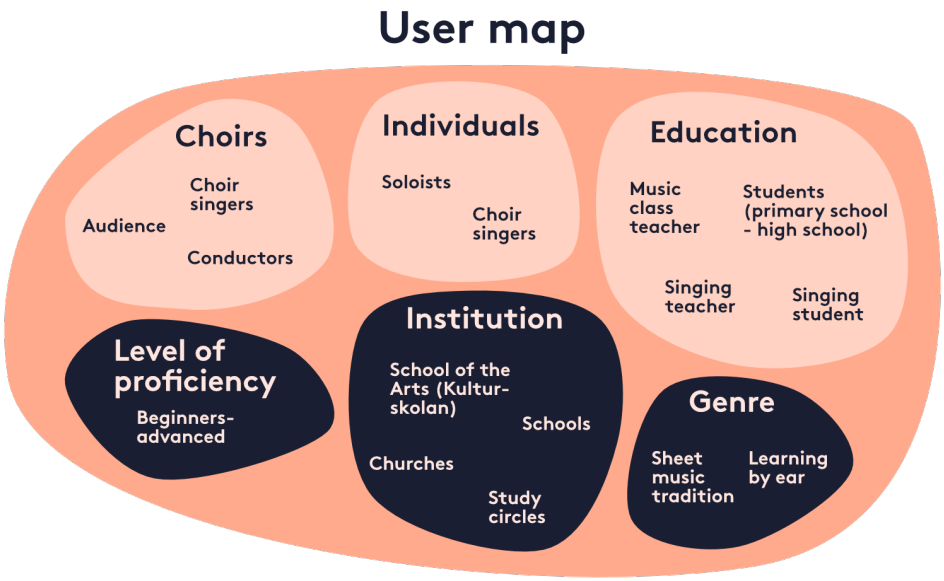


Figure 8. User map, including several user groups and contexts.

As seen in the user map, many different user groups were targeted. It was concluded that choir singers are a quite diverse group with different needs and practices depending on aspects such as levels of proficiency, institution, and genre. For instance, not all users use sheet music for learning - there are genres that have a tradition of learning by ear. In genres where sheet music usage is the common practice (e.g., classical music), there are beginner-level choirs that for this reason do not use sheet music either. On the other hand, there are choirs with high music reading ability, who do not need recordings. The different user groups were not systematized into subgroups, as the contexts often overlap.

3.2 COMPETITOR ANALYSIS

The competitors in the competitor analysis were categorized into three groups (Figure 9); *choir, other instruments,* and *substitutes*. These three groups will be described in more detail below. In general, no market-dominant competitors to We Are Voice were found. The lack of dominant competitors may be a result of regulations regarding musical copyrights rather than the lack of user need. The competitors were analyzed regarding 1) what type of service they provided, 2) the perceived competitiveness, 3) price and payment model, and 4) perceived level of good UX. The results of the analysis will be presented category-wise.

Figure 9. Competitor analysis for three groups; choir (left), other instruments (middle), and substitutes (right).

Choir

Among the choir competitors, the target groups varied greatly. Several of the competitors targeted users that do not use sheet music at all (learning by ear), thus making them indirect competitors. Other competitors only provided users with digital sheet music but no recordings. One of the competitors was a music publisher who had developed a digital service for their choir music. This is a possible scenario for other publishing companies in the future, which could therefore develop them into competitors. Furthermore, the payment models varied, with some providing single-purchase, others term-based course packages, or monthly subscriptions.

Other instruments

The most common services for other instruments found were guitar and piano. Services that targeted other instruments were included in the competitor analysis since some user needs are quite similar and can be solved through the same type of technology. In this other instruments' category, there were several competitors who focused on providing lessons, rather than just sheet music and recordings. However, solo singing lessons have much in common with instrument lessons, making these services highly relevant. Most of the found services used monthly or annual subscriptions, but some competitors also had single purchase options. There were also services that included purchasing sheet music as PDFs and printing options.

Substitutes

The most common substitute found was paper sheet music. Many times, the user behavior is not in accordance with copyright practice; pirate copies unfortunately seem very common. For this reason, using paper copies becomes a cheap alternative. It is common for choir leaders to make recordings themselves. It is also a relatively common behavior for choir singers to record the parts as voice memos during joint rehearsal. Furthermore, cloud storage services (which usually are free) are often used to upload both sheet music and recordings. Music and video streaming services are also common substitutes for recordings, but with the severe disadvantage that they do not provide with separate recordings for each part. Many times, choirs use a combination of the above-mentioned substitutes. Finally, there was a category of substitute product that consisted of electronic ink tablets design specifically for the purpose of replacing paper sheet music. These, however, were quite expensive and did not provide recordings.

4. Ensemble user study

The ensemble user study included several steps and methods (for a more detailed description, see method section). Several themes recurred in both ensembles and during several steps. To make the data understandable and useful, all participants' comments, regardless of which step they were generated from, were therefore integrated into the same KJ analysis. A total of 25 different themes were discovered. The comments from the KJ analysis are presented together with observations and interpretations under the section *KJ analysis & observations*. This is the most comprehensive section of this chapter.

After this section, supplementary results from the study are briefly presented under the sections *Digital diary*, *Focus group*, and *Co-creation*.

Figure 10. Photos from the ensemble user study; focus group statements (left), and co-creation sessions (middle and right).

4.1 KJ ANALYSIS & OBSERVATIONS

From the KJ analysis (Appendix 2), 25 different themes were found. Since ensemble singing is a complex activity, the number of themes was high. User requirements that emerged were color coded with black stickers, attitudes in yellow, and quotes in white (Appendix 2). Below is a summary and interpretation of each theme along with illustrative quotes from the participants (coded with ID number in bottom left corner of each quote). Each theme will also be put into context with observations made during the study.

Mixer / Master

The participants expressed frustration when the piece automatically restarted from top after switching parts. Furthermore, they had found it difficult understanding what the words "Mixer" and "Master" meant, stating that they were more used to the word "Part" (Swe: Stämma"). It was also considered a great flaw only being able to choose between listen to one part at a time or all parts with equal volume, not being able to adjust each part's volume individually. The participants stated that it was essential to hear one's own part as well as the others in order to perceive the full musical harmony, however with the possibility to turn up the relative volume of one's own part. Note however, that the feature of adjusting each part's volume individually already existed in some of the pieces in the music catalog, but not in any of those three pieces used in this study.

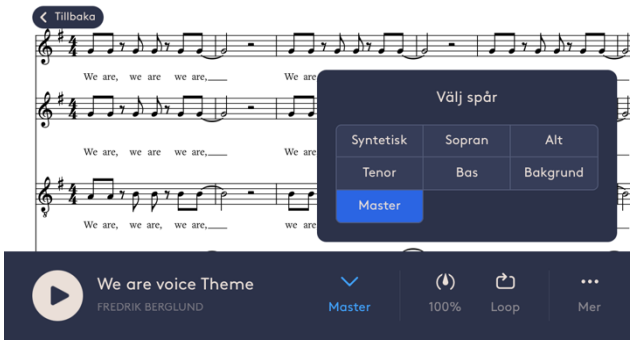


Figure 11. Mixer feature where users could choose to listen to either one part at a time, background, or master (all parts at the same time).

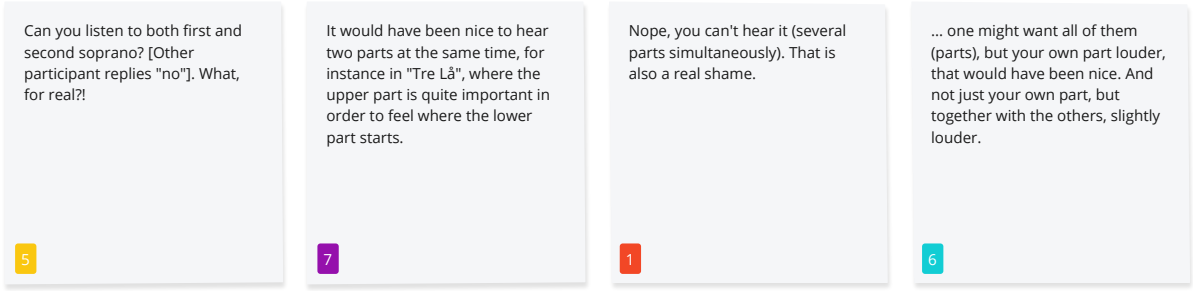


Figure 12. Quotes from study participants related to Mixer / Master.

Measure number and navigation

Users repeatedly asked each other what measure numbers or rehearsal letter to read from, but discovered that neither were to be found in the player. It is common for choir singers who rehearse together to say *"lets start from measure 14"*, to orient themselves and have everybody reading from the same place. Note however, that some of the pieces in the music catalog contained measure numbers, but none of those three pieces used in this study.

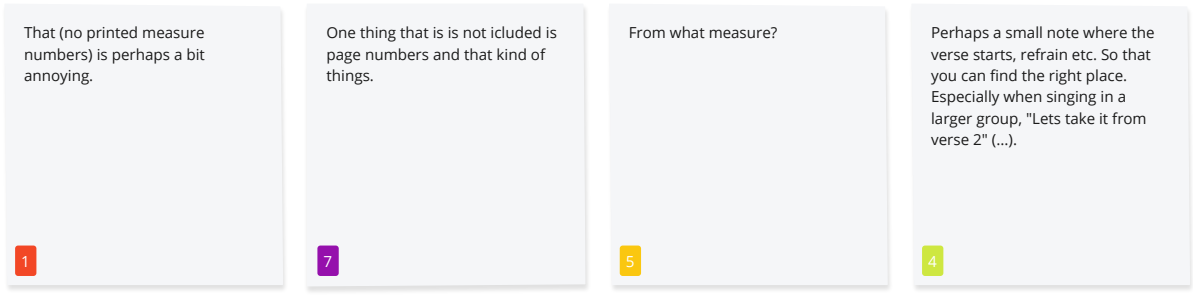


Figure 13. Quotes from study participants related to measure number and navigation.

Offline mode

The participants expressed frustration when the app was loading the pieces, which could sometimes take up to about 10 seconds. This happened when users entered a new piece or switched part. The participants therefore expressed that it would be desirable to be able to download the pieces to local storage or an "offline mode". It also emerged that long loading times could be impractical at, for example, concerts (sometimes held in places with poor internet connection), where it is essential that users have access to the piece without delay. The participants further expressed that the app would consume a large amount of data on the occasions when they want to practice in places without Wi-Fi, for example when listening during a walk.

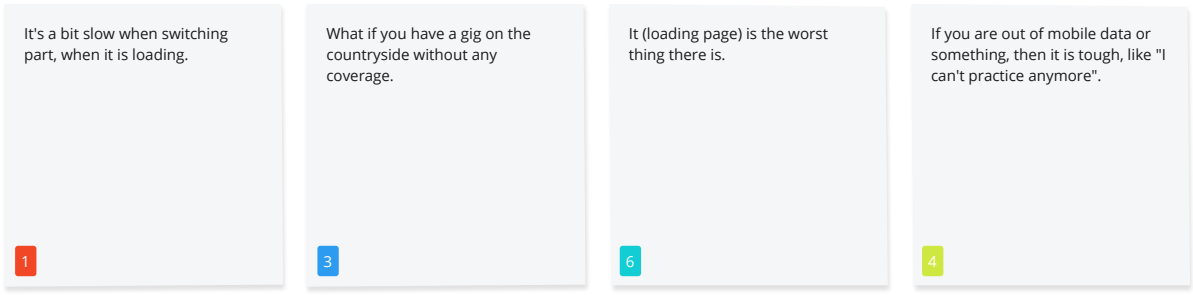


Figure 14. Quotes from study participants related to offline mode.

Loop

The loop function was considered very practical, as it is common to practice more intensively on certain parts of the piece, for example during a difficult passage.

Zoom

Likewise, the zoom function was considered practical in order to adjust the readability. However, some participants thought that a separate button for this was unnecessary, as it is now conventional to use the gestures "pinch" and "unpinch" to zoom.

Using the app's repertoire during concert

The participants were unsure whether they could practically perform the three pieces if it would have been a real concert situation. They stated that in normal cases they would print the sheet music and give it to the accompanist if, for example, they were to perform a solo song. However, neither printing nor saving sheet music as PDF is possible from the app due to copyright issues. They also expressed concerns that even

if a conductor/accompanist could read the music through the app, it was considered impossible to conduct/play at the same time, due to lack of possibility to turn one entire page in one swipe (Figure 15). Another difficulty for the accompanist was a lack of chords or piano parts printed on the screen. This was especially confusing in the pieces *Goliat* and *It's raining men* (*Tre Lå* was a cappella), as the users in the mixer could choose to listen to a background accompaniment and therefore expected to be able to perform the piece in the same way as presented in the recording. The participants chose to use the background music as accompaniment at their fictional concert to solve the problem, but at the same time stated that live accompaniment is considered better and more atmospheric than backing track. However, using the audio as backing track was difficult, since the lyrics in some pieces started immediately without any count-off. This led to participants failing to start at the right time and came in late.

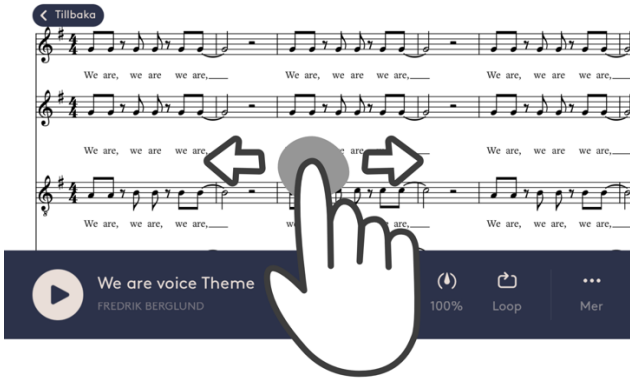


Figure 15. User need to scroll continuously and cannot turn one whole page at a time.

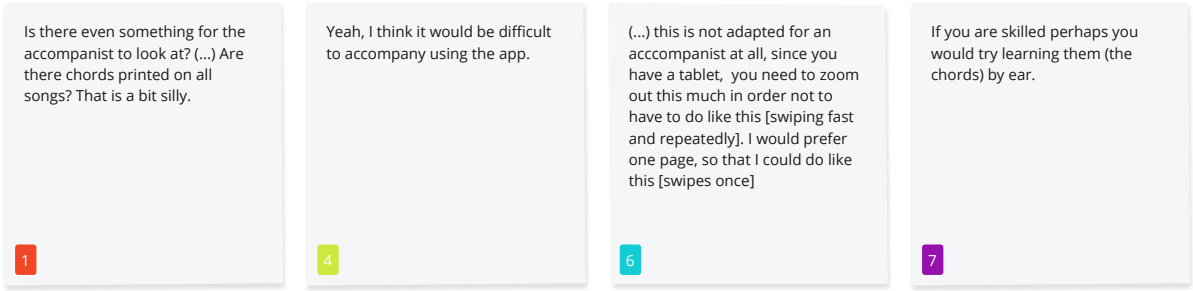


Figure 16. Quotes from study participants related to using the app's repertoire during concert.

Synchronizing devices

The word *"Sheet music with synchronized audio"* (Swe: *Noter med synkat ljud*) confused the participants, who associated the word "synchronize" primarily with "synchronizing devices". From this misinterpretation arose reflections and wishes in being able to synchronize several users' devices during joint repetition in order to, for example, quickly scroll to the same place.

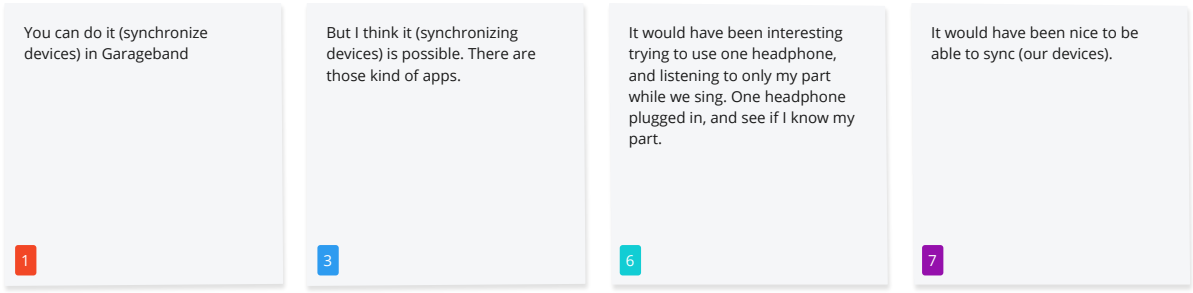


Figure 17. Quotes from study participants related to synchronizing devices.

Metronome, count-off & tempo

As previously mentioned, the need for count-off at a concert was expressed. However, this need also existed during rehearsals, when the participants wanted to start rehearsing someplace in the middle of the piece. In the piece *Tre Lå*, the participants expressed difficulties in practicing in tempo, as they had neither a metronome nor a conductor. Furthermore, it was also found that it was difficult to find the tempo function, because the participants did not understand the symbol nor the text, which consisted of a steering wheel control and the label *"100%"*. The participants at first thought that it perhaps represented the volume.

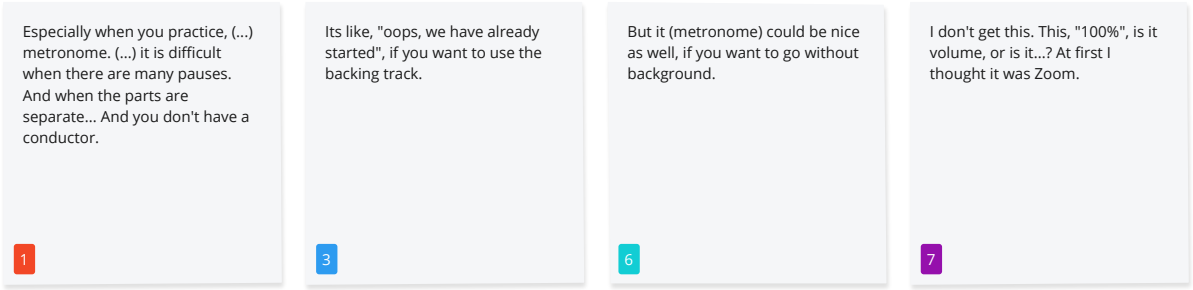


Figure 18. Quotes from study participants related to metronome, count-off & tempo.

Readability of parts

In the vertical page orientation, users had difficulty finding their part in the system. *Tre Lå*, for example, had 5 parts, and the three middle parts were difficult to find after when starting to read on the next row. Repeatedly, they expressed that they jumped into the wrong part, which was due to several reasons; 1) the name of the part was not printed (usually in the left margin on paper sheet music, 2) too frequent automatic row shifts, since the shift occurred despite that several readable rows were visible, 3) in paper sheet music they sometimes mark their parts with a pen or highlighter, which could not be done in the app.

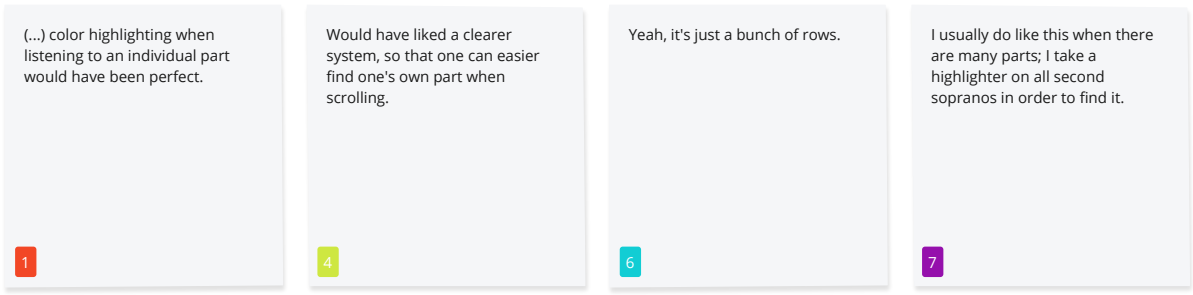


Figure 19. Quotes from study participants related to readability of parts.

Discrepancy audio and sheet music

All three pieces had a couple of discrepancies between audio and sheet music. At one point, two parts were heard even though only one part was selected. On another occasion, the sheet music tones did not match the audio, which created confusion regarding what version was the correct. What caused the biggest problem, however, was that *It's raining men* had almost a whole beat discrepancy between the cursor's location and synchronization of the recording. This resulted in the sheet music becoming very difficult to read, since the sheet music was almost outside the screen.

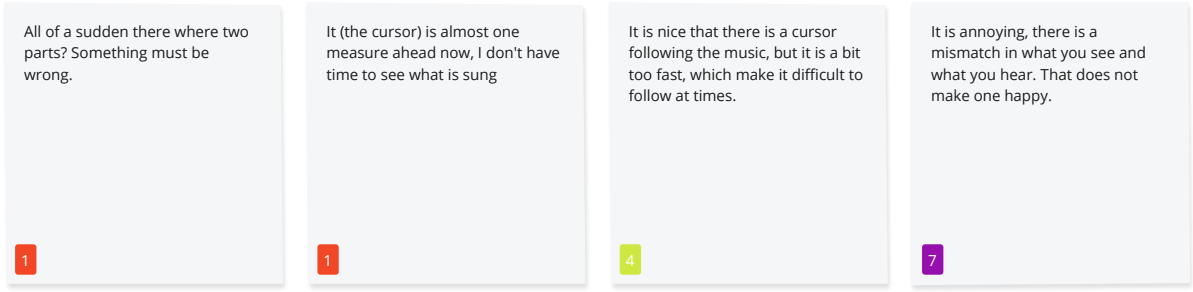


Figure 20. Quotes from study participants related to discrepancy audio and sheet music.

Restricted view of sheet music

All pop-up menus (*Mixer*, *Tempo*, *More*) remained visible (instead of automatically collapsing) after the participants navigated the sheet music. This led users to mistakenly believe that the pop-up menus could not be closed, which they found impractical as they obscured large parts of the note. Furthermore, they considered that the menu in the mobile version was too large and took up too much space in relation to the sheet music. On some pieces and devices, it was also not possible to read the last measure of the lowest part.

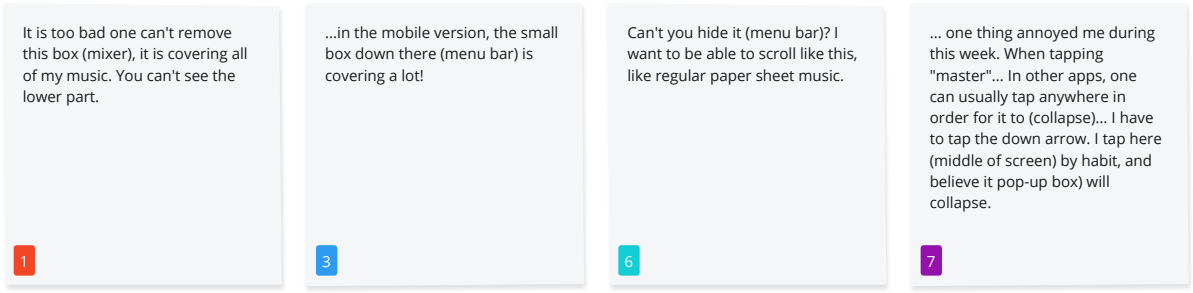


Figure 21. Quotes from study participants related to restricted view of sheet music.

Starting notes

When the participants were to practice together without a background, they needed a starting note. In the Malmö ensemble, there was a piano in the room which they used frequently. In the Gothenburg ensemble, there was no piano in the room they first used, but the participants moved to a room that had one, since they discovered that they could not play the starting note through the app. The only way they could find their starting notes was by tapping play and then pausing, an inconvenient compensation strategy according to themselves. In the Gothenburg ensemble, they expressed that it would be practical to have a miniature piano in the app, even if there are other apps for this purpose, since they would not have to remember all notes when switching between applications.

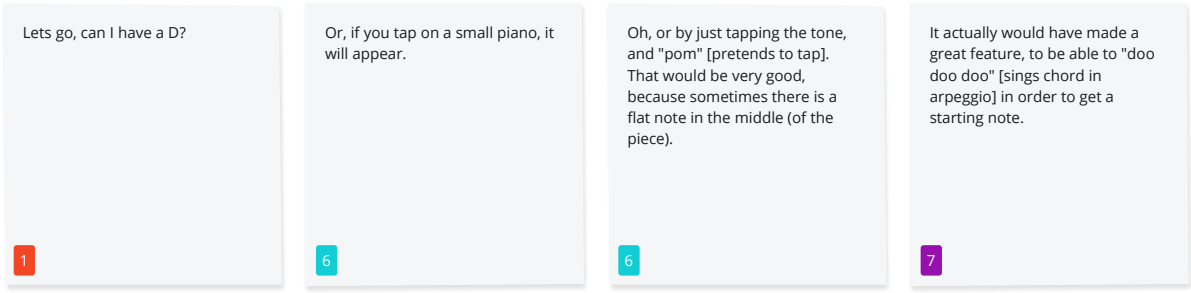


Figure 22. Quotes from study participants related to starting notes.

Scrolling and page orientation

Scrolling and page orientation was one of the most comprehensive themes found in the user study, whereupon some of the needs are already mentioned. An example of such a user need was the ability to turn one whole page in the same way as on a piece of paper (or PDF). The two current views (horizontal and vertical) did not cover all needs for practicing situations. For example, when users wanted to be able to sing at their own desired tempo - this was difficult for them to perform, as the automatic movements (when pressing Play in horizontal or vertical position) determined the tempo. It was also difficult to perform by not pressing play, since they then had to scroll with high frequency while singing, which took focus from the singing itself.

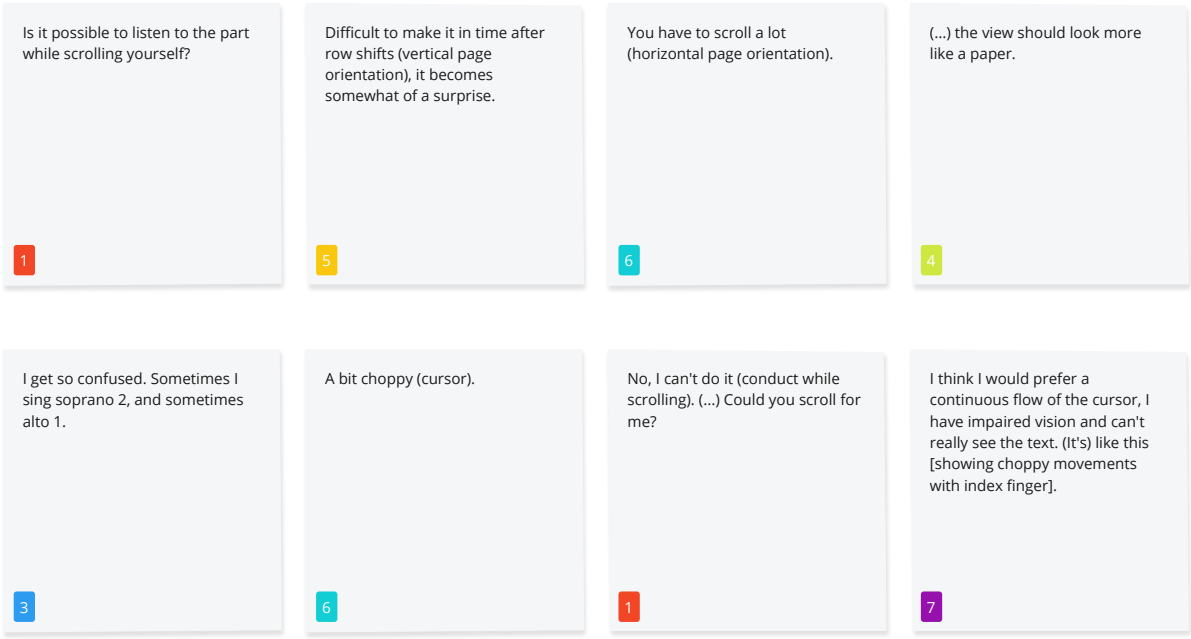


Figure 23. Quotes from study participants related to scrolling and page orientation.

Furthermore, users often tapped in the middle of the screen when the player was running in the false belief that this would pause the player (but this action instead fast-forwarded to the place they tapped on). This created frustration among the users who then had to rewind to correct their mistake.

As mentioned earlier, the vertical view also led to readability difficulties because the player automatically moved after each row, even though several rows were visible on the screen. This was problematic both because 1) each row shift is interruptive and should be minimized in terms of frequency, and 2) the participants are used to reading from left to right, and then moving their gaze down to the left side of the second row (rather than moving the gaze back to the top of the first row).

Another problem that users expressed was difficulty reading the music when the player was running, as the cursor moved erratically. This was a consequence of the measures having different widths (Figure 24). It is common for measures to have different widths; measures containing only pauses are for example usually not as wide as measures with melody, which saves space on the paper. This does not pose a problem when reading sheet music in general, however it does so when simultaneously watching a moving cursor.

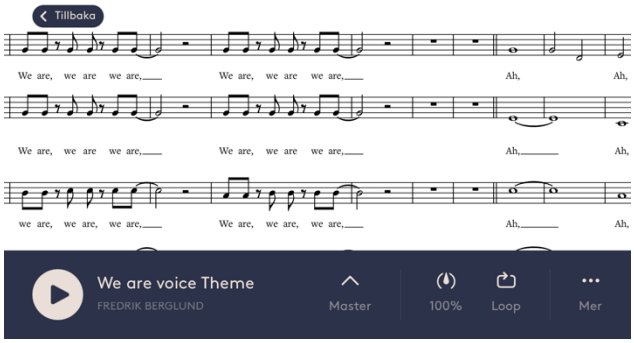


Figure 24. Example of how measures widths are inconsistent due to space saving reasons in measures with, for example, pauses.

Furthermore, users also expressed the importance of being able to read a few beats ahead of singing it. This means that the row shift needs to occur a few seconds in advance.

The page orientation button ("Riktning" under "Mer") lacked clear feedback, and users expressed uncertainty about whether the button indicated which page orientation *was* selected or which one *could be* selected (Figure 25).

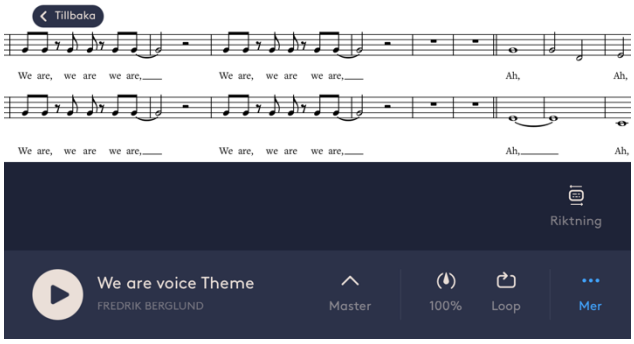


Figure 25. Page orientation button lacked clear feedback for what orientation was currently chosen; horizontal or vertical.

Group versus individual membership

The participants reflected on the difference in signing up for a group membership (where everyone in the choir has access to the app) compared to purchasing an individual membership (for the purpose of only practicing yourself). Most participants saw it as an absolute necessity to sign up for a group subscription because 1) practicing a part becomes meaningful only with the purpose of eventually singing together with others, and 2) if one is already singing in a choir, it is highly unlikely that the app's music catalog has the same pieces or arrangements as those used in the choir.

It was also found that the social aspect of choir singing was very important to the participants and played a big part in making the activity enjoyable. One attitude that was found was that the use of devices for singing could be perceived as less social compared to paper sheet music or learning by ear. It was also stated that being able to listen to co-singers was important. Considering these attitudes towards choir singing and its social components, group subscriptions were preferred.

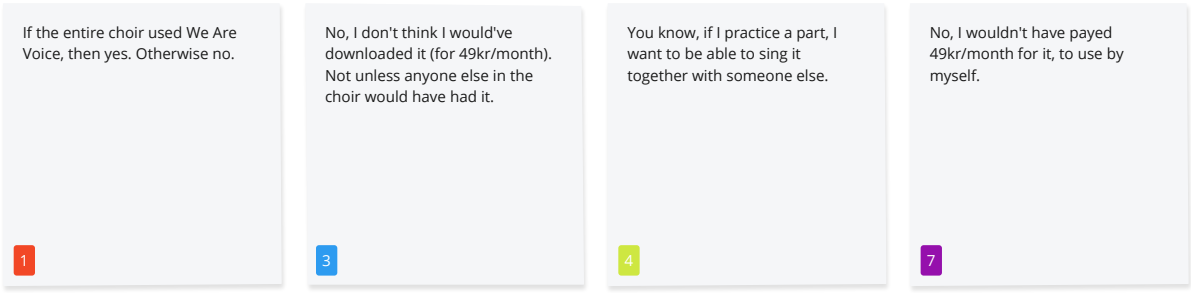


Figure 26. Quotes from study participants related to group versus individual membership.

Comparison between devices

The users thought that the different devices had both advantages and disadvantages. The phone was considered convenient since most people always carry it with them. Tablet, on the other hand, was considered to have significantly better readability, and was therefore preferred in most cases. When the readability was better (tablet in comparison with phone), the participants could also look up from the screen more often, and therefore thought that the tablet was better from a social perspective.

Recording feature

The participants expressed a slightly positive attitude towards the ability to record themselves along with other voices or background. Most people did not consider this to be a necessary feature but believed it could be a fun, additional feature.

Paper sheet music

The participants expressed strong positive attitudes towards paper sheet music, and all participants claimed that they preferred it over digital sheet music for several reasons. First, standard sized sheet music paper (US letter or A4) is larger than most screens on tablets. Typically, music stands and choir binders fits two paper pages. Two paper pages in comparison with a tablet therefore have about 2-4 times as much reading space. For singers, it is important to have a good posture so that the air flow can pass freely without tension in jaw, neck, and shoulders. Good readability is therefore essential for maintaining a good posture without leaning forward. Furthermore, it is easy to make notes on paper, which is a common practice in choir and solo singing. Participants expressed a desire for the opportunity to purchase individual arrangements for PDF and paper printing. Paper was also considered "genuine" and a way to reduce screen time. However, a couple of benefits of digital notes were highlighted; environmentally friendly when not printing, easier to carry than a heavy binder, enabling practice on the go, and the opportunity to organize and store everything in the cloud.

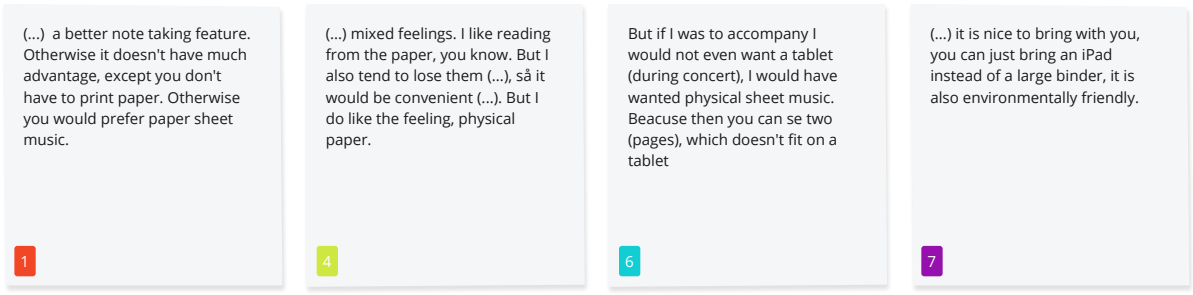


Figure 27. Quotes from study participants related to paper sheet music.

Taking notes

As mentioned above, the singers wanted the opportunity to take notes straight on the sheet music. There was also a desire to be able to see the choir leader's notes, which could be convenient since one could easily miss important, verbal instructions.

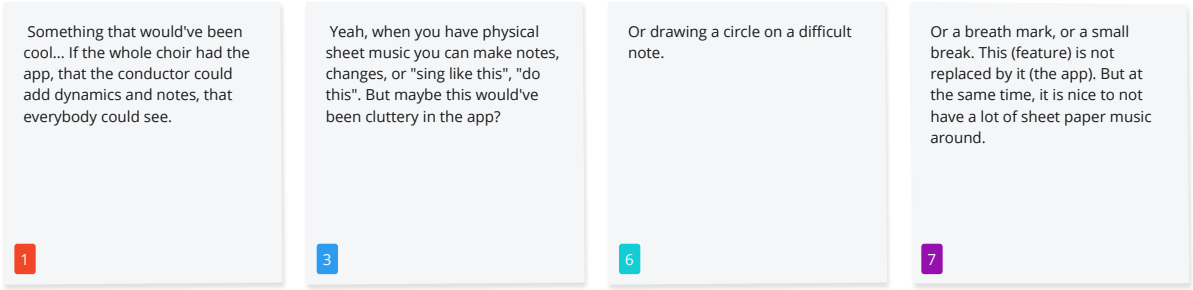


Figure 28. Quotes from study participants related to taking notes.

Learning by heart

Attitudes varied greatly between the participants regarding how much repertoire they believed was reasonable to learn by heart before a concert. Some of the participants claimed that an hour's repertoire was possible to learn by heart if one just practice enough. Others thought this was unreasonable. The different opinions were partly due to habit and proficiency, but also to the type of genre. In classical music, it was considered a common practice to use sheet music during concert, since the repertoire often was too difficult to memorize. In other, popular musical genres, it was more common to sing by heart. In some genres, such as gospel (which has an oral tradition), it was considered common to learn entirely by ear, and hence also natural to perform the piece by heart. Common to all participants, however, was that it was preferred to sing by heart, as it made the singers more expressive and improved the contact with the audience.

Using devices during concert

The participants did not want the audience to see a device being used at a concert, as it could impair the atmosphere. Although devices (usually tablets) were sometimes used at concerts, they were careful to hide it behind a music stand. It was also mentioned that devices could give off a light on stages with dimmed light, which probably would not be appreciated by the audience. However, there were also opinions that such a light could be used as an artistic effect, at the same time as it improved readability. Some participants requested a device with electronic ink (often

used in reading tablets) as this was more analogous to paper notes and did not emit any light.

As previously mentioned regarding a static PDF view, it was found to be important to be able to turn the page in one swipe during concert. The participants saw no possibility for either conductor or accompanist to be able to use the sheet music at a concert in the current design due to the frequent scrolling.

Likewise, the need to have some type of count-off when using a backing track at a concert was emphasized, as the pieces started immediately. This was problematic both because 1) the singer does not catch the tempo and misses the first part of the piece, and 2) it is desirable to have time to go up on stage and prepare before the piece starts playing.

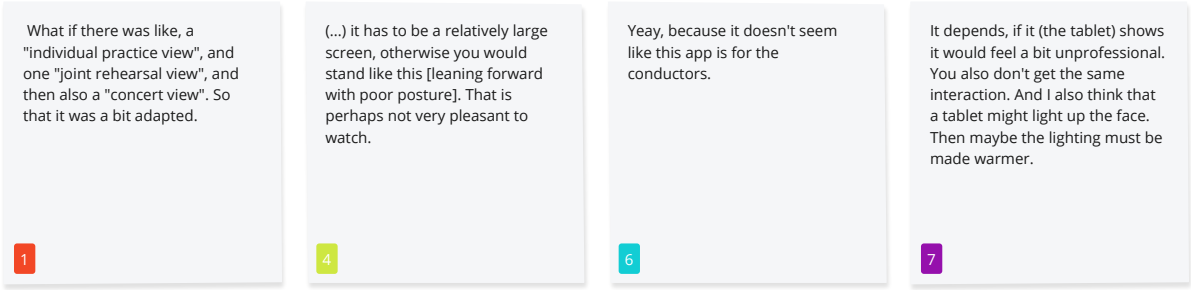


Figure 29. Quotes from study participants related to using devices during concert.

Upload own arrangements

The participants thought that it was a practical feature to be able to upload their own arrangements, as it is then possible to collect all the material that the choir uses in the same place.

Solo singing

Singing with live accompaniment was considered preferable over performing with a backing track, although there were situations when backing tracks could be acceptable. Practicing at home with backing tracks was considered useful and enjoyable, although they were unsure if they were willing to pay for it (due to available free material for this purpose on other streaming platforms).

Individual parts recordings

Individual parts recording was considered an important learning tool for the choir singers who wants to practice individually between joint rehearsals and who are not advanced music readers. The users thought that the individual parts recordings had a very high value for the conductor who then would not have to make own recordings. It was also considered convenient for choir singers who themselves record their parts during the joint rehearsals in order to practice at home. Furthermore, it was appreciated among the participants that the recordings consisted of real voices instead of MIDI files, and that these maintained a high professional level.

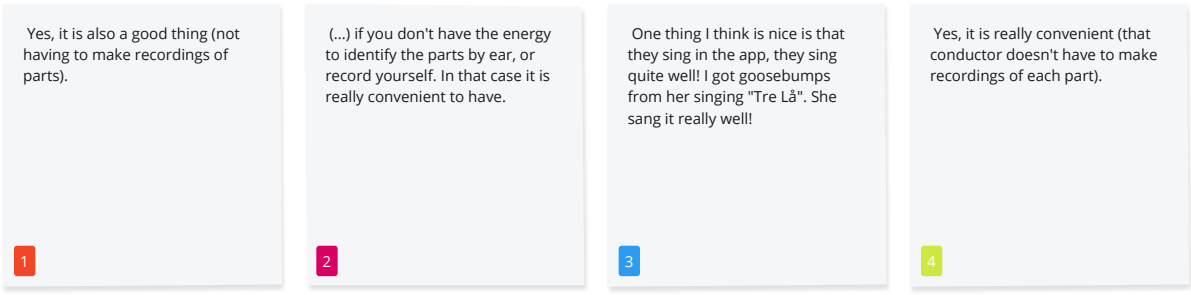


Figure 30. Quotes from study participants related to individual parts recordings.

Musical expression and dynamics

The participants noted that there were no dynamics or musical expressions printed in the sheet music. However, this seemed like a desirable feature, but with less priority in comparison to other aspects.

Other

One feature that the participant asked for was the ability to play audio from the app through a locked phone screen, as the user could then practice by listening while doing something else. Playlists for different seasons were also requested; a feature already included in the app, but was not presented to the participants due to being outside the scope of this thesis.

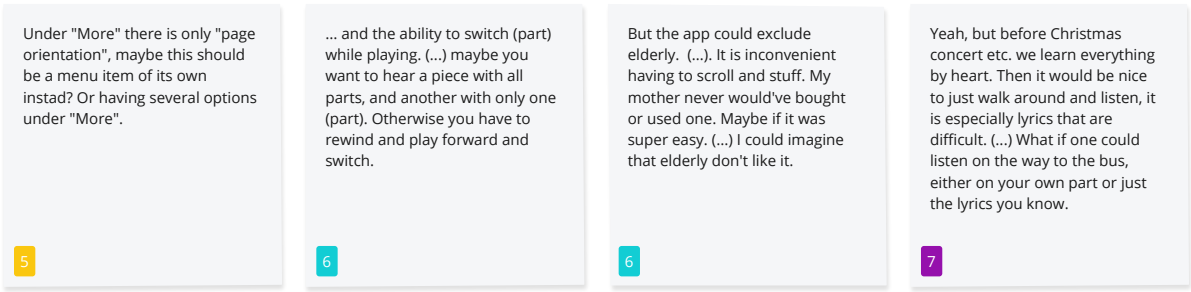


Figure 31. Quotes from study participants that was found in category "other".

4.2 DIGITAL DIARY

As previously mentioned, the participants' responses from the digital diary were presented in an integrated KJ analysis and observations section. The digital diary generated relatively few answers (see discussion section). However, Figure 32 shows the timetable for the diary questions as well as three examples of diary questions.

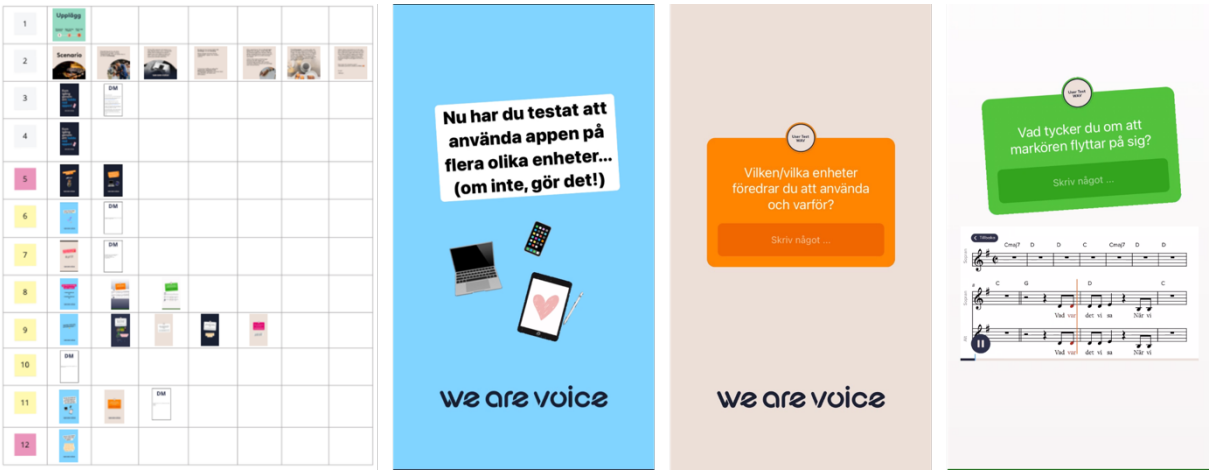


Figure 32. Digital diary for The ensemble user study. Timetable for posting diary questions (left), and three examples of diary question posts (right).

4.3 FOCUS GROUP

The focus group step consisted of two parts; (a) *statements* and (b) *reactions to alternative digital sheet music representations*.

Figure 33 shows pictures from the first part. The statements were connected to six different user perspectives that the participants were asked to reflect on; *choir singers, conductors, audience (for choir concert), solo singer, accompanist,* and *audience (for solo concert)*. The comments generated was included in the KJ analysis.

Figure 33. Focus group discussion material. Six paper bags (one for each user perspective) containing statements that participants were asked to take a position on.

The second part, the reactions to alternative digital sheet music representation, consisted of showing the participants four videos. These videos were chosen with the purpose of showing a wide range of alternative ways of presenting digital notes to the participants, who could then vote, react, and express their preferences.

The first clip had a cursor with diffuse contours, almost like a "cloud" moving over the note. The second video had a cursor similar to We Are Voice's current cursor, but was moving in pulse instead of continuously, and therefore acted as a kind of metronome. In the third video, there was no cursor, but the current note being played changed its color to red. In the fourth video, the player had no cursor, but the entire current measure was highlighted while the other measures were dimmed. After each video was shown, the participants discussed (these comments were also presented in the KJ analysis) and rated their experience from 0 (strongly dislike) to 7 (strongly like) through the digital voice tool Menti (Figure 34).

Figure 34. Attitudes regarding four different digital sheet music representations (menti.com, 2021), with scale spanning from Strongly dislike (0) – Strongly like (7).

4.4 CO-CREATION

The co-creation session was the last step that the participants performed in the study, and thus summarized the participants' opinions (Figure 35, 36). By finishing the study with an analogue build-their-own app workshop, they were able to express the preferences that they had formed during the past week. The comments from the workshop while building their own app is also represented under "KJ analysis & observation". For all co-creation results, see Appendix 3.

Figure 35. Co-creation template given to participants, along with stickers and pens.

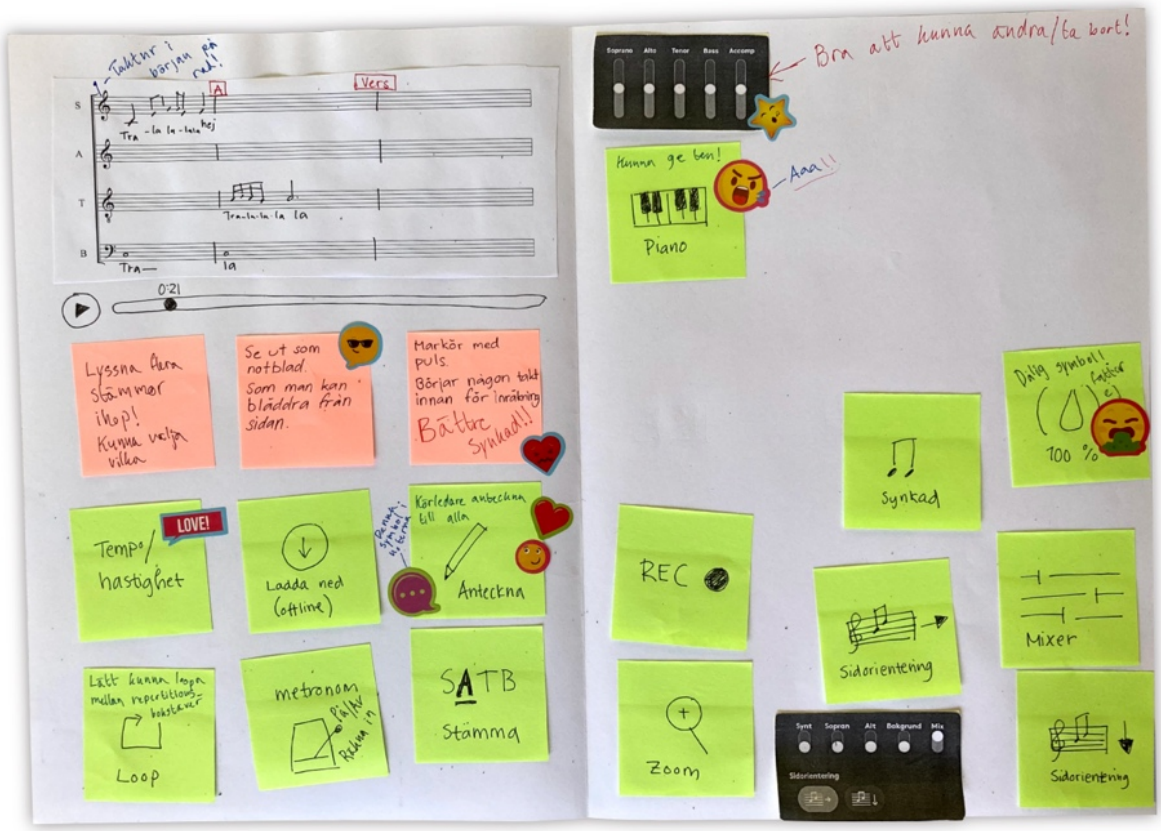


Figure 36. Example from co-creation sessions, where participants in pairs “built-their-own app”.

5. User Survey

The questionnaire, which was sent to all users with a registered We Are Voice account, was answered by 90 respondents. Of these, however, only 31 people had a paid membership (either Premium or Member, Figure 37). Since most features in the app is locked without paid membership (the music catalog is locked except for a few single musical pieces), some answers from non-paying users were irrelevant. From such questions, the non-paying sample has been excluded. Other questions, such as demographics, attitudes, or the repertoire the choir sings, were considered relevant and therefore included. Results from the total sample (N = 90) are displayed in grayscale, while results from paying users (n = 31) are displayed in color.

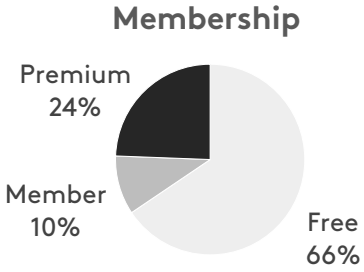


Figure 37. Percentage of respondents with membership Premium, Member, and Free.

The majority of users sang in a choir with mixed voices; that is, in a choir with both women's and men's parts (Figure 38). In the total sample, these users consisted of 73%, and among paying users 87%. Other voicings, such as women's choir, men's choir and unison choir, accounted for less than 17% respectively. The majority of the sample consisted of women, 69% in the total sample, and 58% among the paying users (Figure 38).

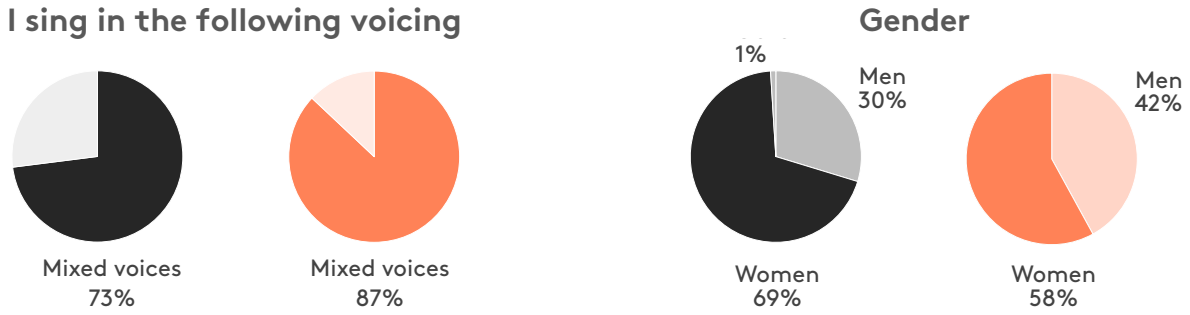
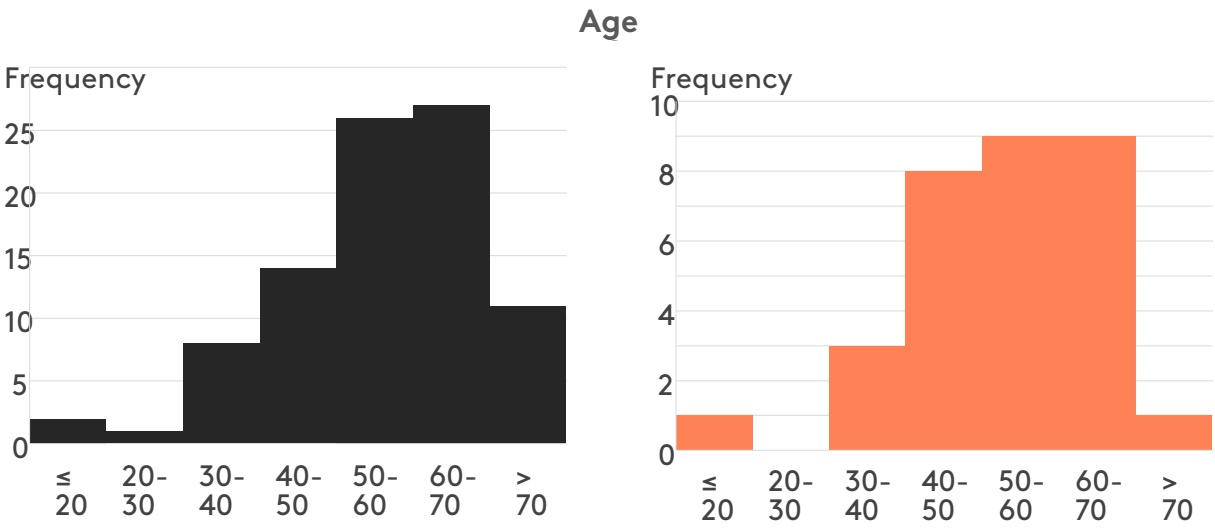


Figure 38. Amount of respondents singing in a mixed voicings choir (left) and gender (right).

In the total sample, 13% considered themselves soloists, while in the paying sample it was only 7%. Furthermore, the ages in both samples were relatively high, with a large range of users of ages 50-70 years (Figure 39).



Figur 39. Histogram showing age distribution among the respondents in the total sample (left) and the paying users (right).

The music reading ability in both samples was relatively high (Figure 40). This was unexpected, as there was an assumption that good music reading ability made the individual parts recordings as a learning tool unnecessary.

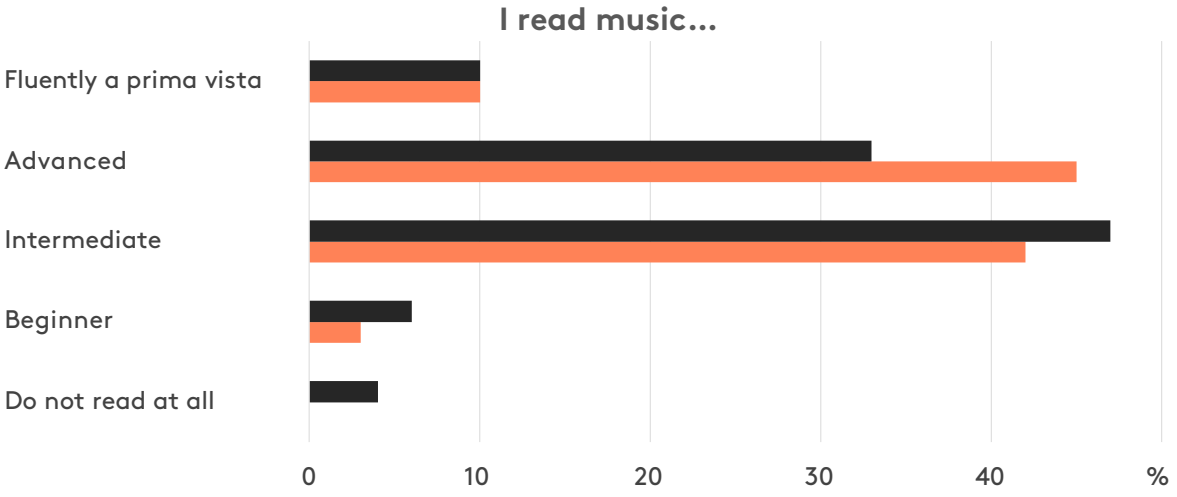


Figure 40. Diagram showing the user's self-rating of their own music reading level.

Questions regarding which genre (*classical, pop / rock / jazz, gospel, church music, folk / songs, a cappella, other*) the choirs most often sang was diverse, and no genre stood out.

Most respondents preferred to perform by heart at concert (Figure 41). This was an important finding from a design perspective, as one can then make the assumption that the app does not necessarily have to be used by the choir singers for reading music during a concert. Furthermore, the respondents had negative attitudes to performing with an iPad during a concert, and relatively neutral attitudes regarding performing with paper sheet music.

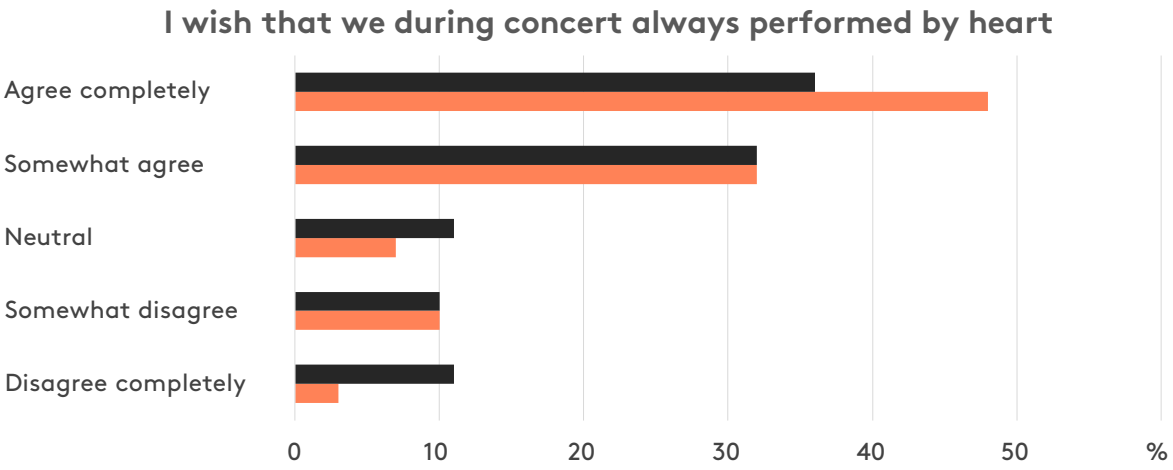


Figure 41. Attitudes regarding performing by heart during concert.

In order to understand how the respondents used the app in different situations, they were asked which devices were used in the situations *individual practice* and *joint rehearsal* (Figure 42). Respondents were able to make multiple choice answers. For this question, only paying customers' answers were relevant. For individual practice, the phone was the most common device (~65%), followed by tablet (~50%, counting all tablet sizes). The responses differed greatly from the usage at joint rehearsal, where the most common was not to use any device at all (~70%), followed by phone (~30%).

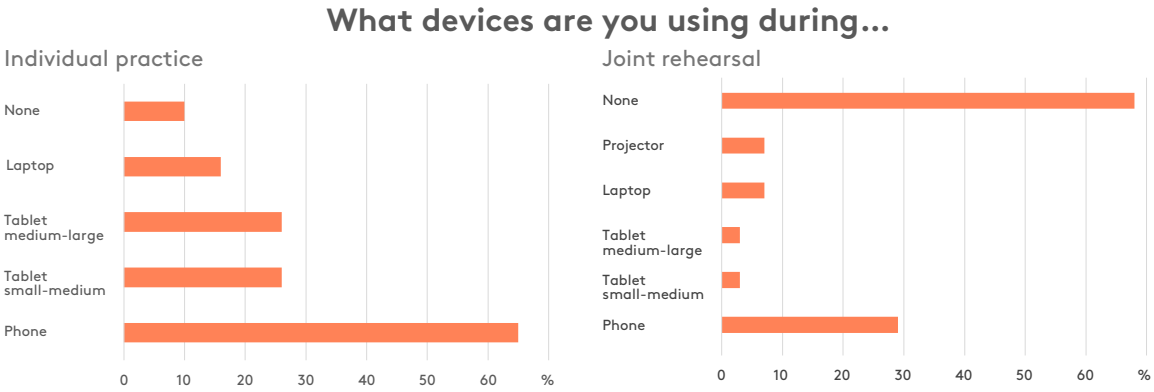


Figure 42. Usage of device type during individual practice and joint rehearsal.

The respondents were asked to state freely how they used the app's repertoire at a concert, to which the largest proportion answered that they had not used the app's repertoire at a concert. Recurring answers were also that they used to learn the repertoire by heart or to obtain paper sheet music.

Furthermore, they were asked if they lacked any function, whereupon the following themes were mentioned; *possibility to play music with a locked screen, download to offline mode, possibility to purchase paper sheet music, printed measure numbers, possibility to listen to several parts at the same time,* and possibility *to upload own arrangements* (existing feature).
Participants also rated the perceived value of various features in the current app (only relevant for paying customers). It turned out that the most valued functions were the professionally recorded individual parts recordings (figure X), as well as being able to listen to their own part separately. Highly appreciated functions were also the opportunity to gather all the music in one place, and that the conductor did not have to record the parts.

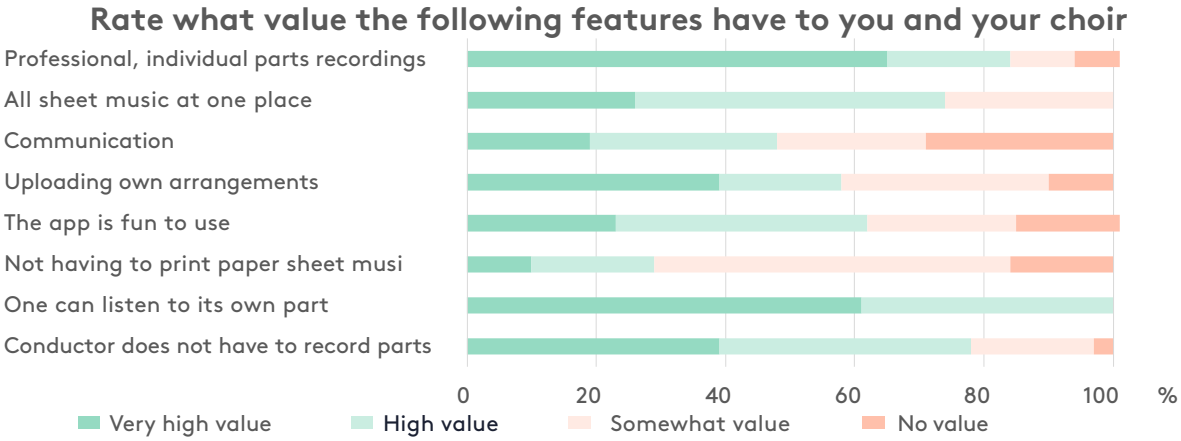


Figure 43. Respondents ratings of perceived value of existing features.

Furthermore, the participants estimated which new functions they were interested in (Figure 44), whereupon *offline mode* was the most valued function, followed by *taking notes*. There was also some interest in a *recording feature*, while *more solo material* only generated a slight interest.

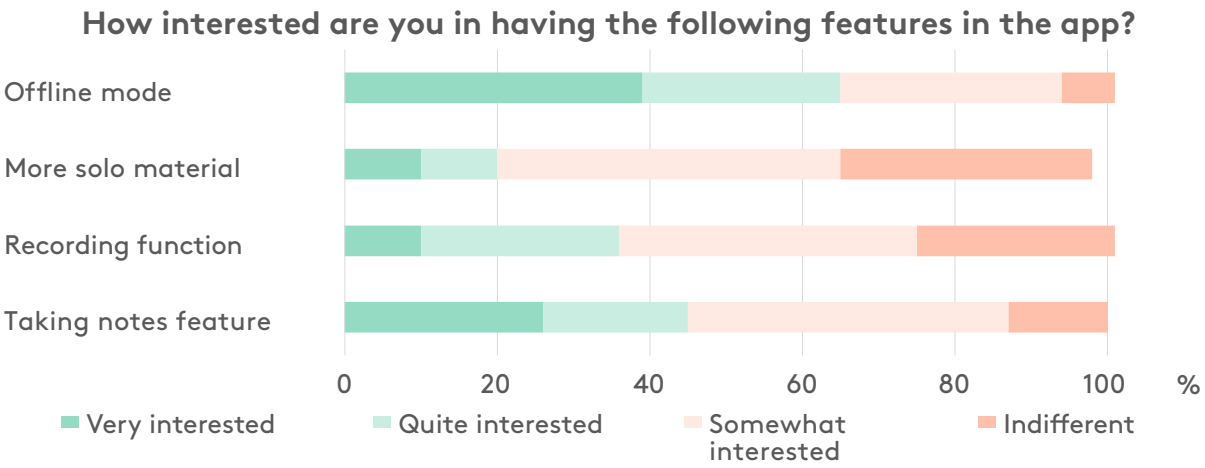


Figure 44. Respondents ratings of interest in new features.

6. Synthesis User Studies

The current app, according to most users, needs a few improvements in terms of user experience and usability, but overall work well for choir singers when *practicing individually*. The two most important needs seem to be (1) the ability to listen to several parts simultaneously and to customize the volume for each so that the harmony is audible, and (2) ergonomic readability. To solve these needs, a re-design of the interface might not be sufficient, since the appearance of the media player currently depends on the type of file format and quality of the musical content.

In the future, it could be a good idea to prioritize the user groups (e.g., genre), since they have slightly different practices and contexts. For instance, in pop/rock/jazz it is common to call the piece a "song", while in classical music it is referred to a "composition" or "piece". Words such as "repertoire" or "playlist" also might be context specific, and the UX writing and labels in the app will therefore communicate a target group. Also, learning a piece by *reading* sheet music is more common in classical singing than in pop/rock/jazz, where one often *learns by ear* (and hence might only need recordings, not sheet music, to practice). During performance, using sheet music in a binder or on a music stand is more common in classical music than in pop/rock/jazz. Another difference is how the accompanist's part is presented; in classical music the part is often notated in the bottom of the system, in pop/rock/jazz there are usually chords printed on top of the system. There are also differences in the usage of backing tracks during concerts, which are quite uncommonly used by classical singers. The content of the music catalog plays a large part in communicating to the user who the target group is.

When it comes to using the app for joint rehearsals or concerts, a few problems occur. In both these situations, other types of users (conductors, accompanists, audience) are also interacting with the app. For instance, a conductor and accompanist cannot conduct or play while using any of the current page orientations, since they would have to scroll continuously and simultaneously. This is less of a problem for choir singers, who has their hands free, even though it might not be very ergonomic for longer sessions. In order to practice the repertoire during joint rehearsals, the choir singers must either use their phone (which is a bit difficult to read from due to small screen size), own a tablet (which is common, but not the case for all singers) or learn the piece by heart before the first joint rehearsal (which is an uncommon practice). It is also less likely that a conductor or pianist would like to learn the piece by heart, since they are often professional musicians who each week perform and rehearse a much larger quantity of music than do the choir singer. Also, an accompanist cannot play the background that comes with some of the

pieces if there are no chords or piano part printed. Likewise, the lack of an offline mode could also be a problem that hinders the users from performing the app's repertoire on a concert, since no backing track nor sheet music would be accessible with poor internet connection.

Like previously mentioned, these mentioned needs are less important to the *choir singer* when *practicing individually*. However, if the consequence is that the choir cannot perform the repertoire on a concert, it seems to reduce their willingness to sign up for a paid subscription. In the Ensemble User Study, no participant was willing to neither practice nor pay for learning a choir piece that would or could not be performed (note however, that learning and paying for a solo singing app was considered to be interesting). The standard substitute product for choir singers is paper sheet music (and occasionally recordings), and it currently seem to be the preferred learning tool. Paper is often cheaper, enables notetaking, has a larger reading area, and is perceived as an authentic tool. It is therefore inevitable that users will compare all other types of singing apps to paper sheet music.

According to Activity Theory, the *mediating tool* (app) must be purposeful to the *subject* (singer) in order to obtain the *object* (performance). This means that the product, in order to be purposeful, must work in *all* situations (individual practice, joint rehearsal, concert) as well as for *all* users (singers, conductors, accompanist, audience). The most valuable feature, that paper sheet music does not provide, is recordings of separate parts. The app also has several other appreciated features that provided high value for the users (e.g., professional recordings, large music catalog, ability to upload own arrangements), and therefore has great potential of becoming a better mediating tool than paper. To summarize; with a holistic and systemic approach, the user experience could be enhanced, and the app made useful throughout the whole user journey; joint rehearsal - individual practice – concert.

7. Ideation

7.1 SKETCHING & BRAINSTORMING

Brainstorming (Interaction Design Foundation, 2021) was performed through writing and sketching by hand (Figure 45) for each of the discovered user needs presented in the previous chapter. Likewise, brainstorming was used to find ideas for categorizing different features and modes based on type of users and situation. This strategy was essential, since We Are Voice's aim is to target a broad span of user groups and situations.

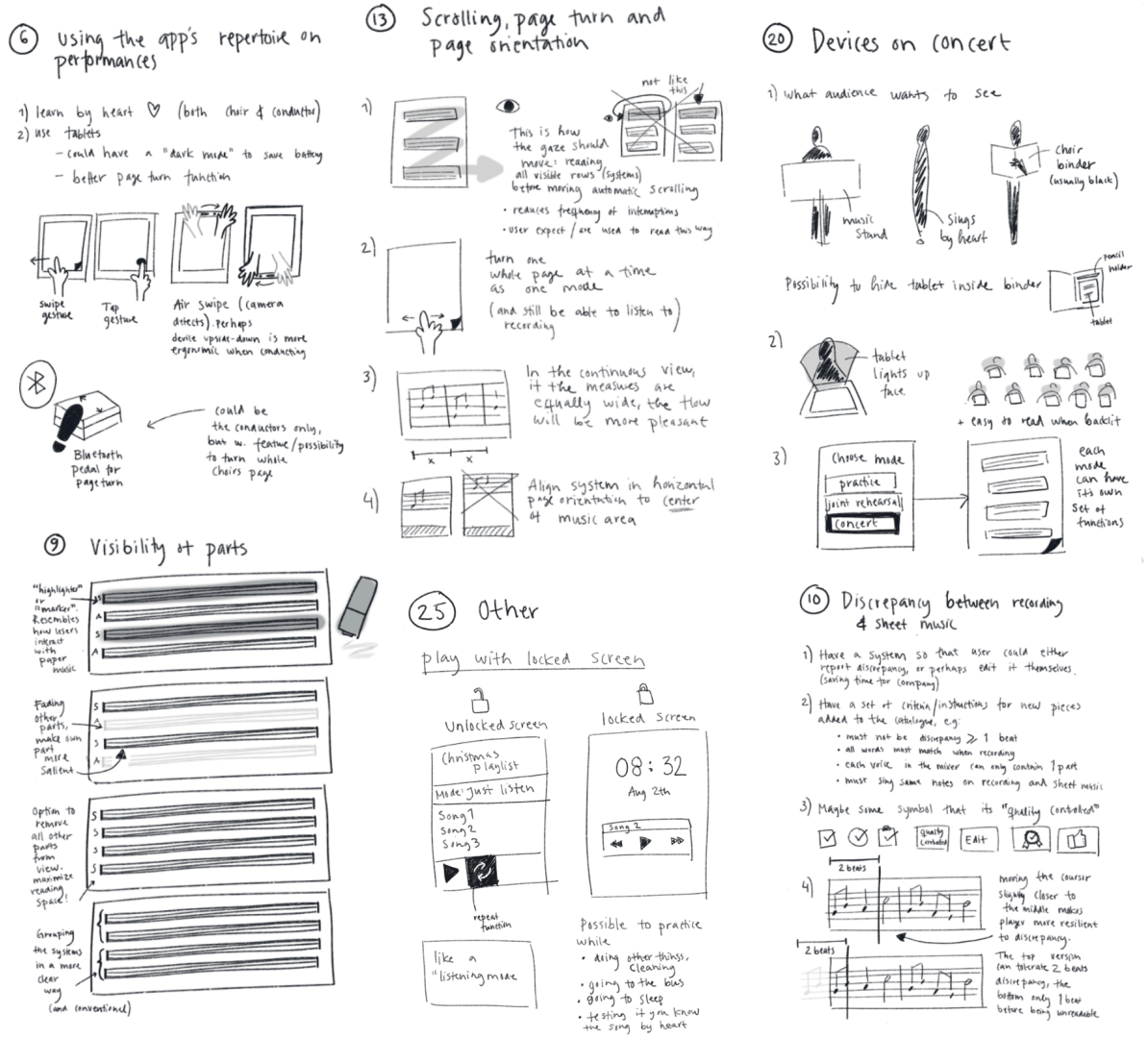


Figure 45. Extract from ideation and brainstorming sketches.

After this initial brainstorming session, three concepts were designed containing combinations of solutions and were visualized as a low-fidelity prototype in Figma (2021). Each of the concepts had its own focus area; the individual user, the small group user, and the large group user. Each current user of the We Are Voice app falls into at least one of mentioned focus area. The purpose of the different focus areas

was partly to outline what distinguishes different situations and user groups, and partly to create contrast and discussion material before designing the final concept.

7.2 CONCEPT A: THE INDIVIDUAL USER

The individual user does not sing in any choir but has downloaded the app to become a better singer on her own. Phone is assumed to be the most used device in this concept, however tablet is also frequently used.

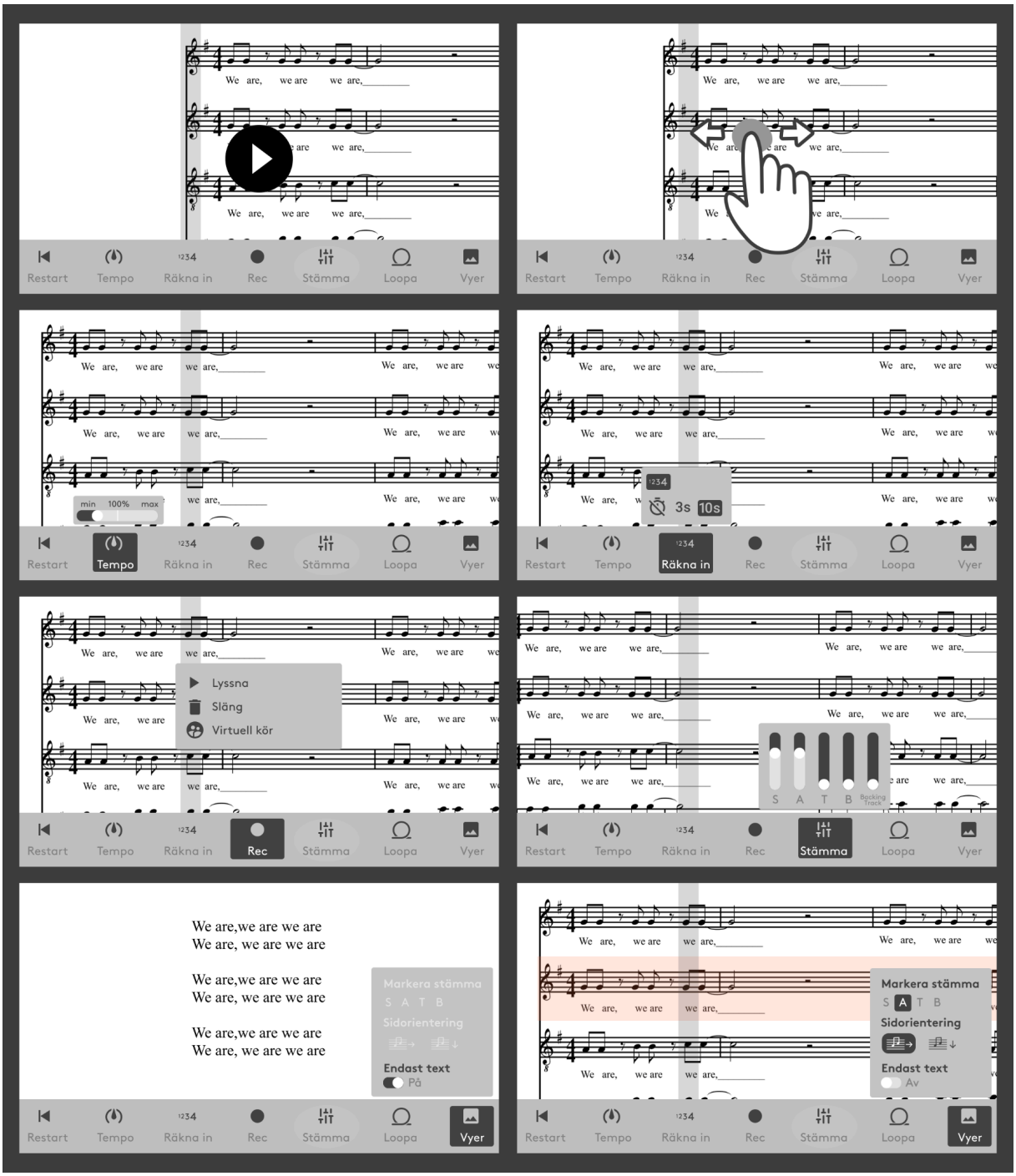


Figure 46. Concept A: The Individual User.

The cursor has been made slightly wider for increased readability. All measures do now have equal width, which will make the cursor move with constant speed (and thus not erratic). To save space on the screen, the play button has been removed and is now located in the center of the screen. Through the gesture horizontal scroll (instead of tap), the user can now navigate in the piece without accidentally fast forwarding. The tempo button has the same symbol as before but has been labeled *"Tempo"* instead of *"100%"*. The button in the slider snaps to 100%, in order to facilitate resetting to original tempo. Since the song starts immediately in some of the pieces in the catalog, a count-off feature has now been added, labeled "Räkna in" (Eng: Count-off), in order to help the user get into the piece in time. Furthermore, there is also a timer function so that the app can be used as a backing track at a concert. The timer allows the user to prepare or move to the stage after pressing play. Another new feature is also the record feature, which allows the user to record herself with other parts and/or backing track. To make the app more interactive and enjoyable to users who do not sing in a choir currently, a virtual choir co-creation feature, "Virtuell kör" (Eng: Virtual Choir) has been added. Furthermore, the mixer now has the label "Stämma" (Eng: Part) and has continuous sliders on *all* pieces in the catalog so that the user can adjust the volume of each part and thus hear the full harmony if they choose to. The loop function is the same as before, but has been given a new symbol that matches conventions of other music software. Under "Views" (Eng: Views), the user can choose to highlight her part ("Markera stämma"), change page orientation ("Sidorientering") or to only show the lyrics ("Endast text").

7.3 CONCEPT B: THE SMALL GROUP USER

The Small Group User sings in a small ensemble of 4-6 people without any conductor. They typically use tablets as they gather around the kitchen table to practice together. A couple of features are the same as in Concept A, but with a couple of differences.

The *jam function* (Figure 47) allows users to synchronize their devices through Wi-Fi. This means that all users can easily follow the sheet music at the same place without having to scroll at the same time. By pressing "Led ensemble" (Eng: Lead ensemble) the user controls the units of the other device. There is also a small piano keyboard so that users can play the tone, in case they do not have a piano or other instrument at home. Under "Vyer" (Eng: views), the user can choose to mark its part, which makes the other parts fade. The user can now choose between 3 different page orientations, the first two operate in the same way as in the previous app, but with some modification of the vertical page orientation. In this design, the page is automatically moved upwards only after all visible systems have been displayed (pink arrow in figure 47 illustrates the intended eye movement), which improves the readability. The third and new page orientation is a static PDF view where the user navigate by swiping the pages. Since the group does not have a conductor, there is also a metronome with a BPM slider to help keeping the tempo.

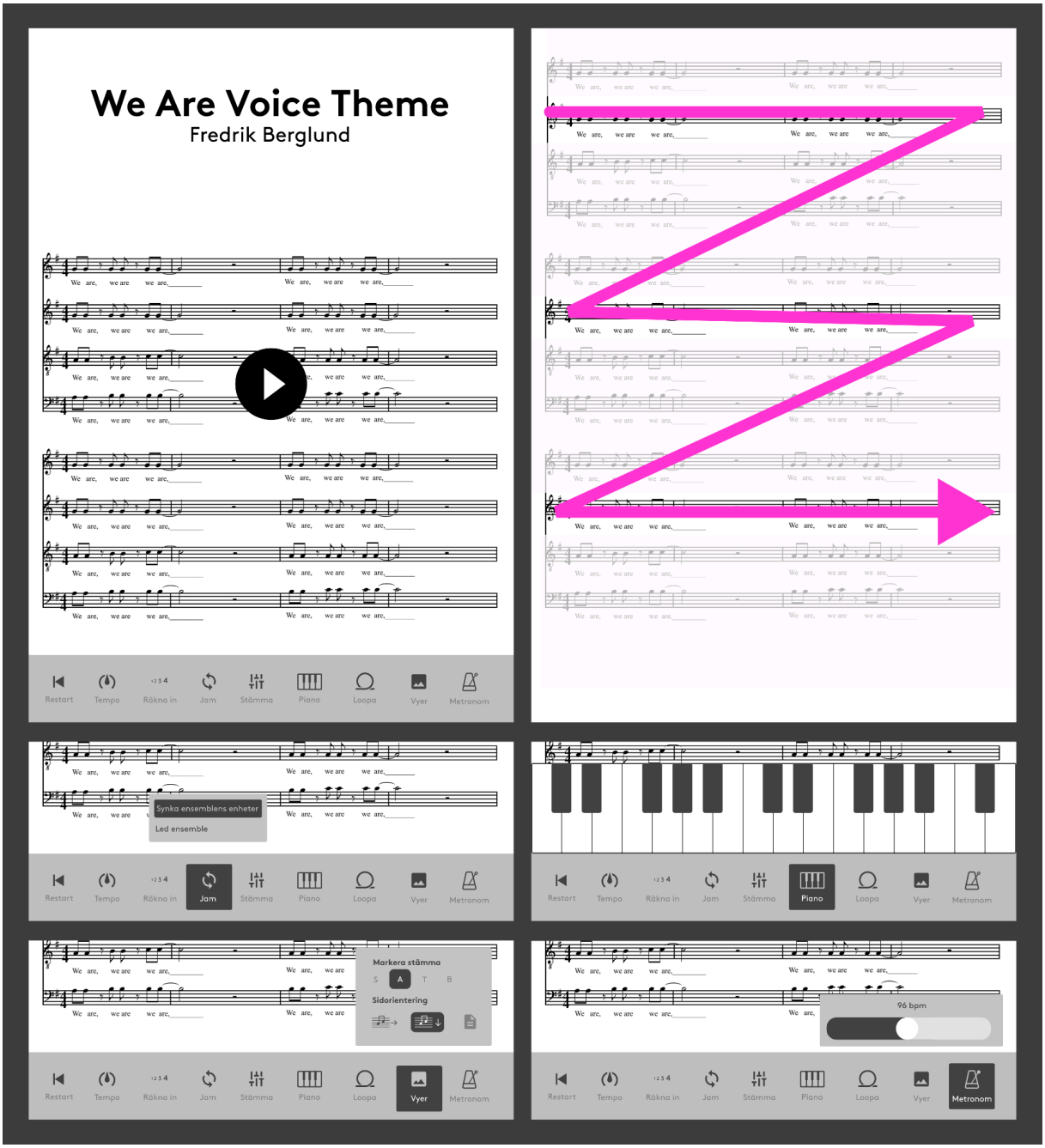


Figure 47. Concept B: The Small Group User.

7.4 CONCEPT C: THE LARGE GROUP USER

The Large User Group is the type of user that is the most common at We Are Voice at the moment: a large group of singers with a conductor. In concept C, the conductor has the option to share notes with the rest of the choir and for this reason there are two interfaces; choir singer and conductor (Figure 48). These interfaces are otherwise identical. In each interface there are two modes available; *View* and *Play / Edit*.

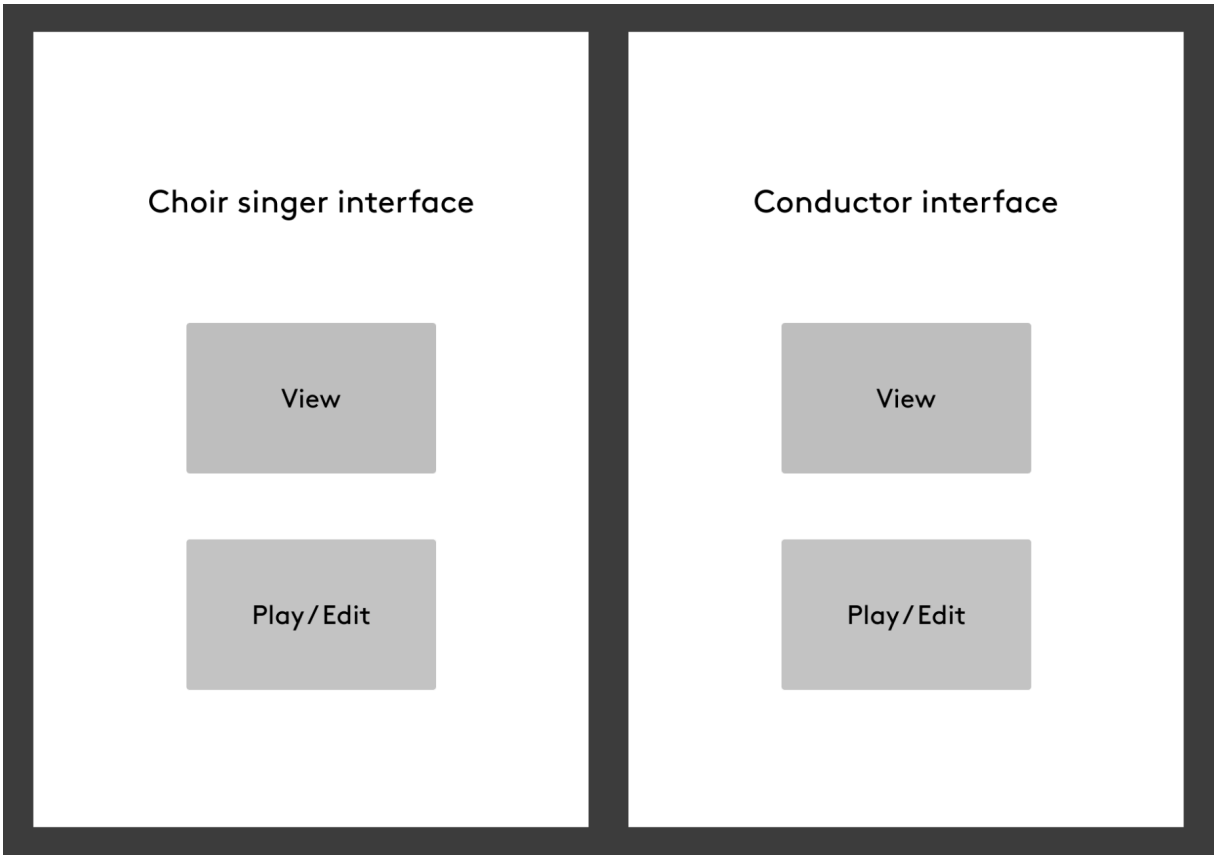


Figure 48. Two different interfaces; one for choir singers (left) and one for conductors (right).

The View Mode

The *View* mode is most suitable for concerts, where it is easy to view the notes without any distracting options that take up space from the sheet music. In the *View* mode one can choose whether show the chords (usually desired in jazz / pop / rock repertoire), which makes it possible for an accompanist (could be the choir leader himself) to play along. Furthermore, it is possible to choose which parts you want to see (for example SA in a SATB arrangement) and piano part for those pieces that have one (usually classical repertoire). It is also possible to show or hide notes and choose a color theme. At a concert, it can be advantageous to choose one of the darker color themes so that the audience is not disturbed by the light from the tablet. Finally, the user chooses how to turn the pages, by tapping, swiping or with a Bluetooth page turner pedal. The latter is to be recommended for conductors and accompanists since it allows them to have the hands free for conducting and playing.

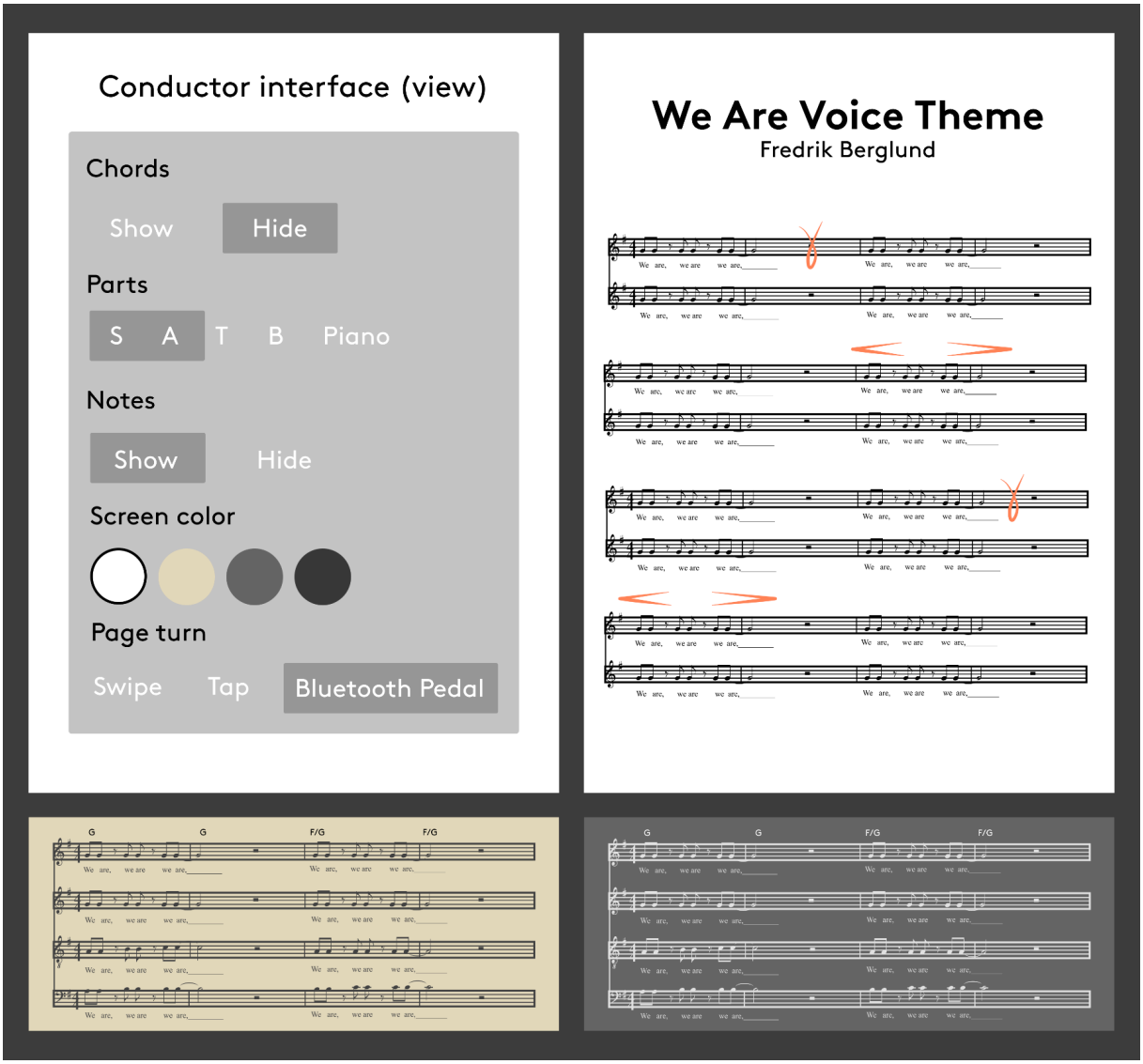


Figure 49. Concept C, View Mode.

The Play/Edit Mode

In *Play / Edit Mode*, the user can listen to the recordings. Similar to the *View Mode*, the *color theme* (Swe: Färger) can be chosen. *Tempo, Loop* and *View* are the same as before. New for this mode is that you can make *notes* in the static PDF view for, for example, dynamics and breathing. You can also choose to show / hide your *own notes* (Swe: Egna) and the *choir leader's* (Swe: Körledares). This feature is convenient, as the choir singers sometimes miss noting instructions from the choir leader. The Part mixer (Swe: Stämma) has the same appearance as previous concepts.

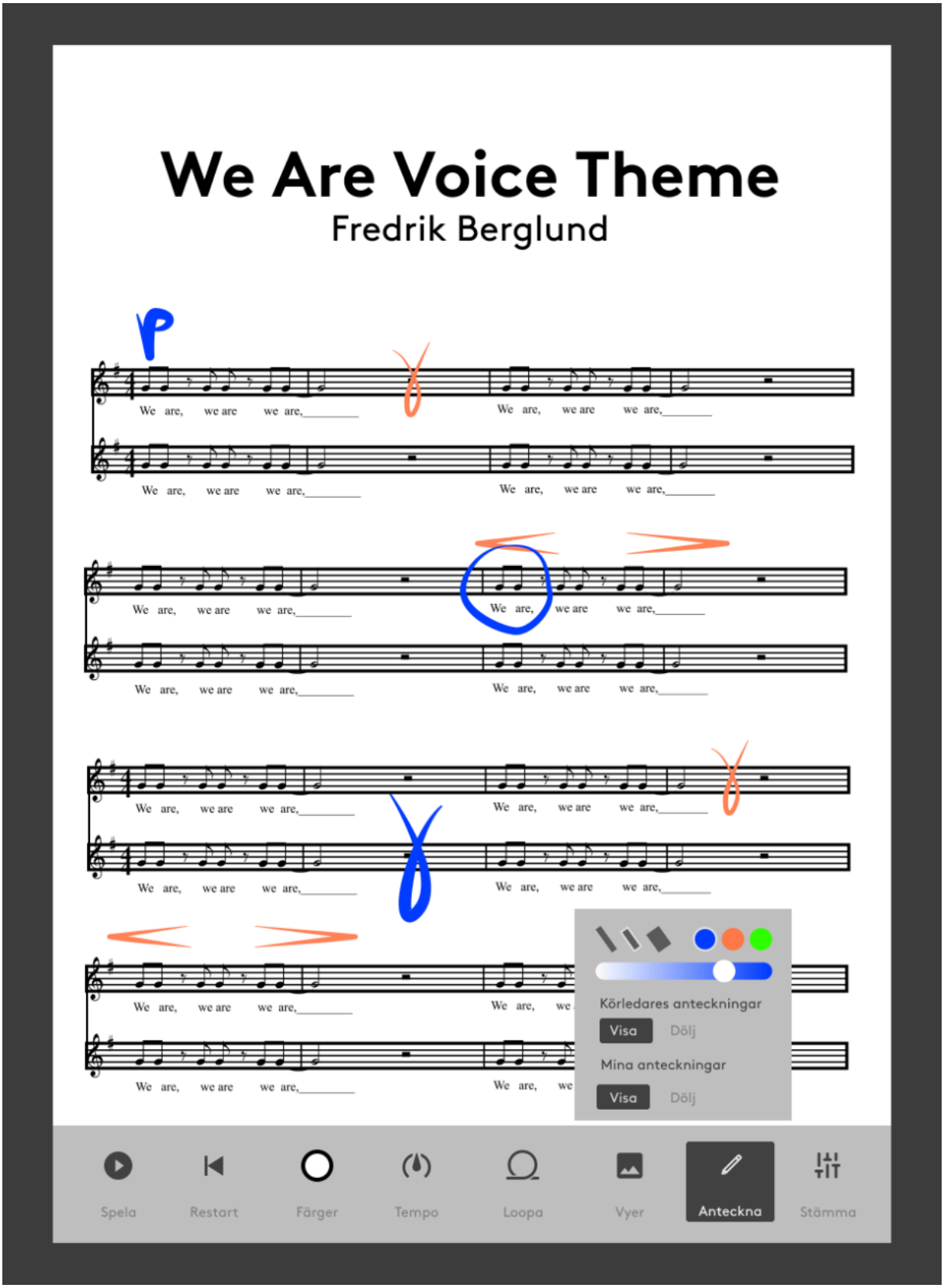


Figure 50. Concept C, Play/Edit Mode.

7.5 ALL USER GROUPS

For all concepts, there is also a separate mode where one can listen and learn by ear while simultaneously doing something else. The playlist can be started, one can

shuffle and repeat, and continue playing the recording when the screen is locked. In order for the playlist not to consume large amounts of mobile data and to also function offline, it is now possible to download the pieces to local device storage.

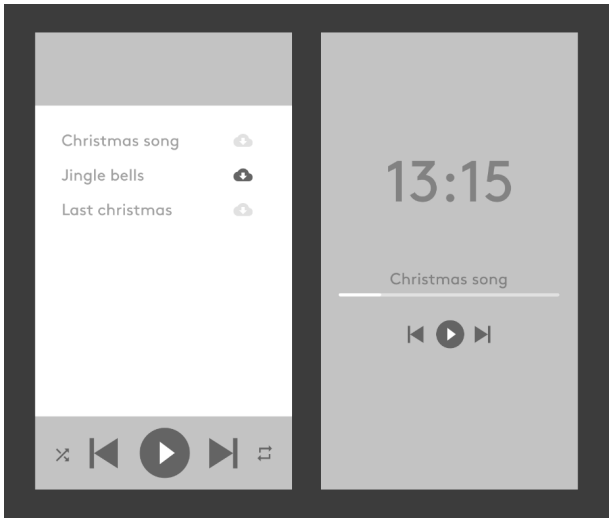


Figure 51. Download to the pieces and listen to playlist with locked screen.

7.6 WE ARE VOICE'S FUTURE DIRECTION

After presenting the results of the two user studies as well as concepts A, B, and C to the stakeholders, it was decided in dialogue with We Are Voice which direction the further development would go. We Are Voice's wishes and strategies for future target groups were considered.

Prior to the final concept, the following target groups was included as potential users: choir singers, conductors, solo singers, singing teachers, accompanists, and music teachers. Performers of all genres represented in the music catalog would also be included. All organizations where singing occurs would also be kept in mind for the future design.

Less relevant users were the individual user (who does not sing in any social context but buys the service herself, without connection to group packages) and small group user, who lacks a conductor.

8. Design concept

To fit all targeted situations and users, four different user modes were created. These user modes were categorized by situation rather than user group, since users in the same situation have more needs in common than do users from different groups (for example, conductor, choir singer).

The two upper modes are intended for rehearsal situations, and the lower two for concert. Having several modes in the design makes it possible for each user to follow a user journey and with good usability perform the same activities with the app as it would have carried out with paper sheet music. The second concert mode is only available on tablet and is displayed as a locked choice (gray) in the mobile version, communicating to mobile users that more features are available on tablet.

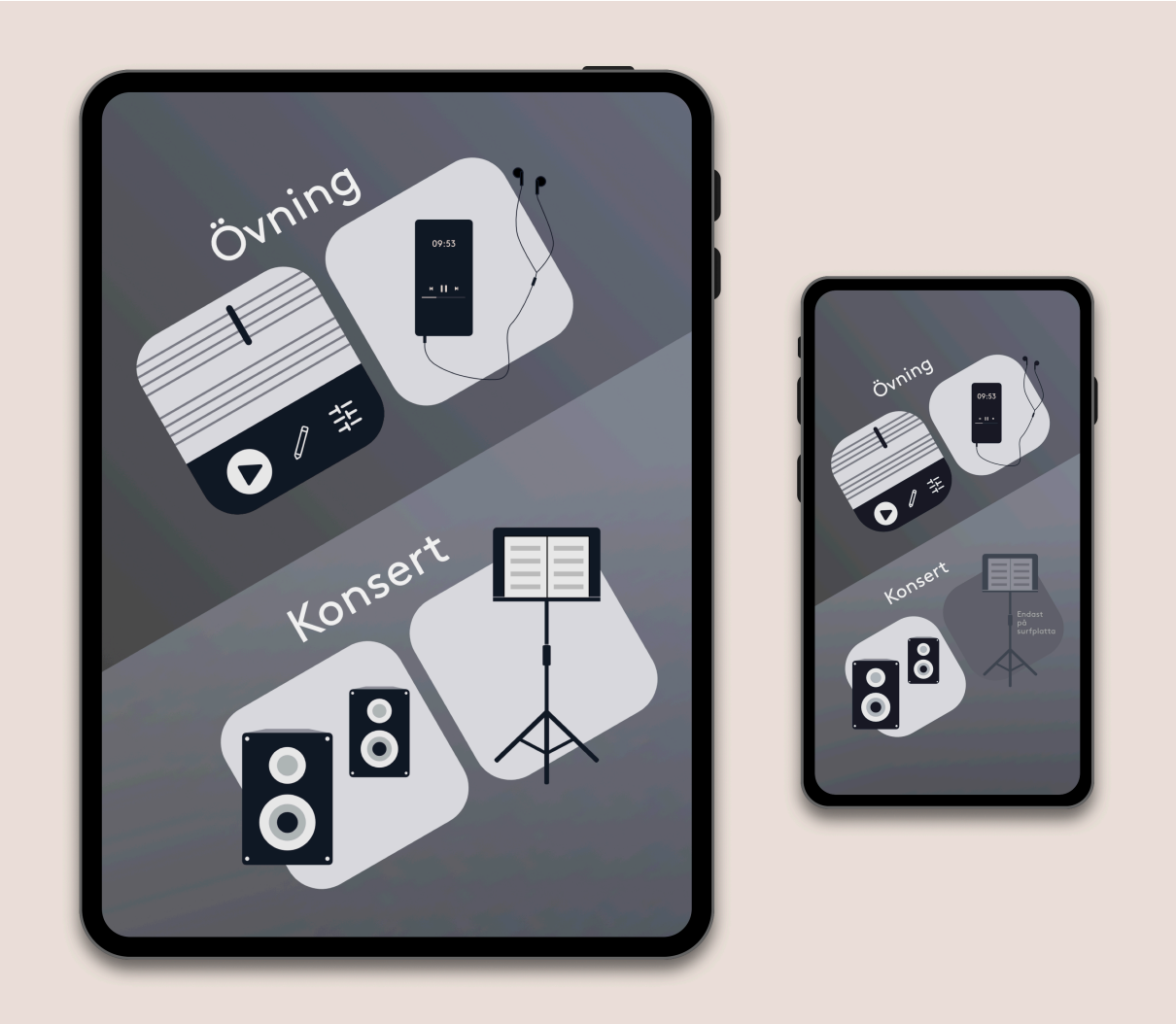


Figure 52. Four user modes; two for rehearsal (top) and two for concert (bottom).

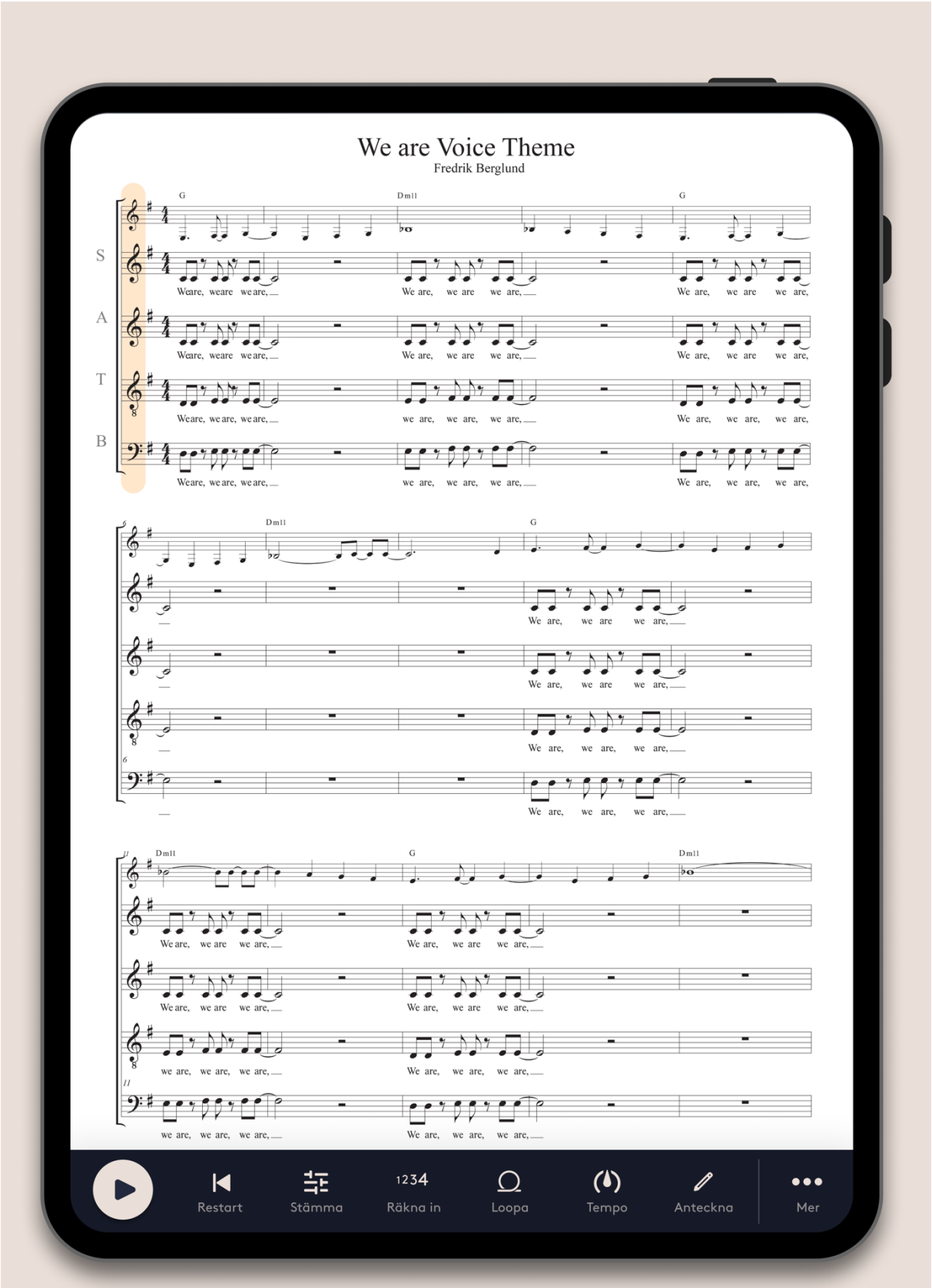


Figure 53. Practice Mode 1: Sheet Music & Audio. Features (from left to right): Play, Restart, Part, Count-off, Loop, Tempo, Notes, and More.

Figure 54. Practice Mode 1: Sheet Music & Audio. Pop-up menus for Parts, Count-off, Loop, Tempo, Notes, and More features.

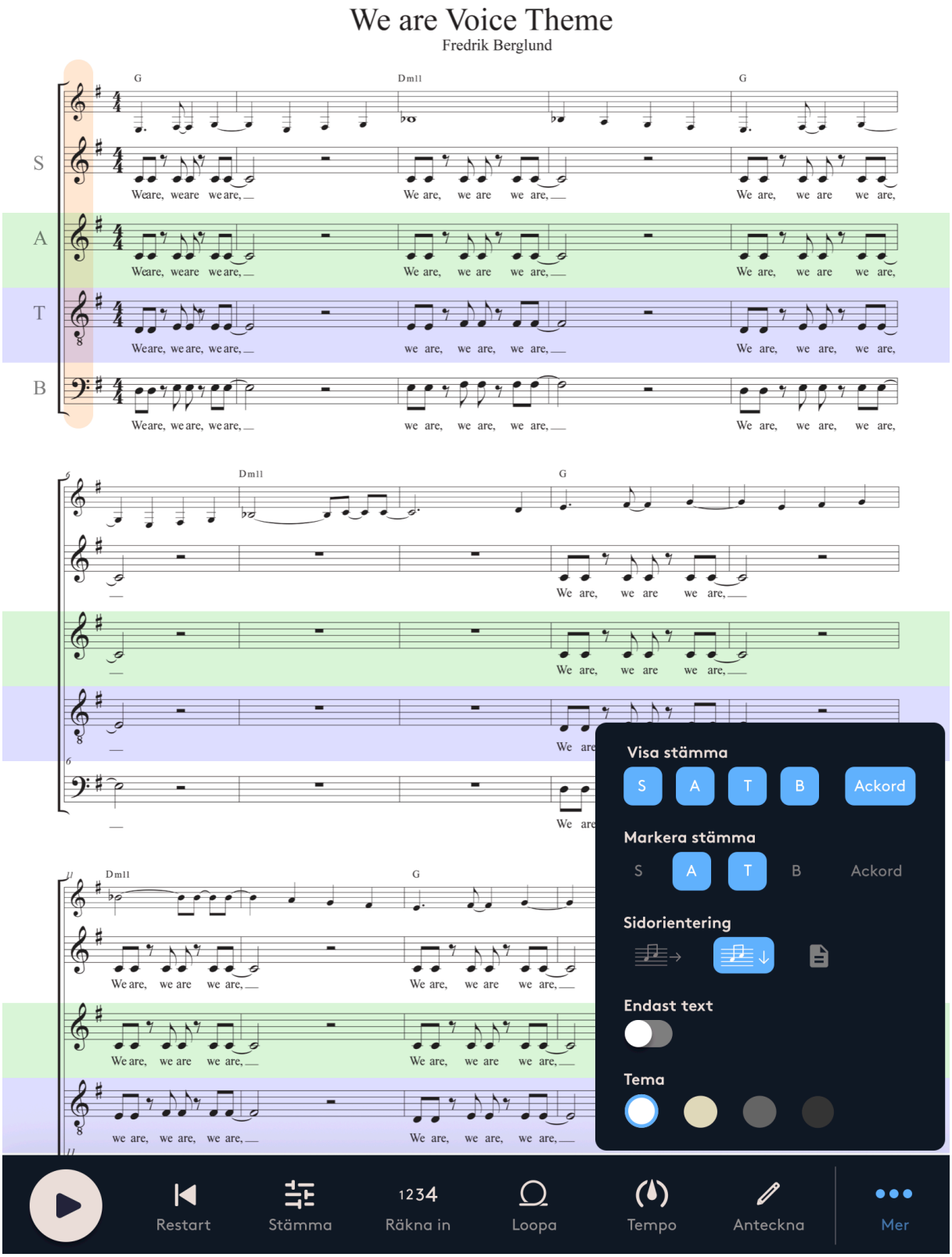


Figure 55. Practice Mode 1: Sheet Music & Audio. "Markera Stämma" activated, highlighting alto's part in green and tenor's in purple.

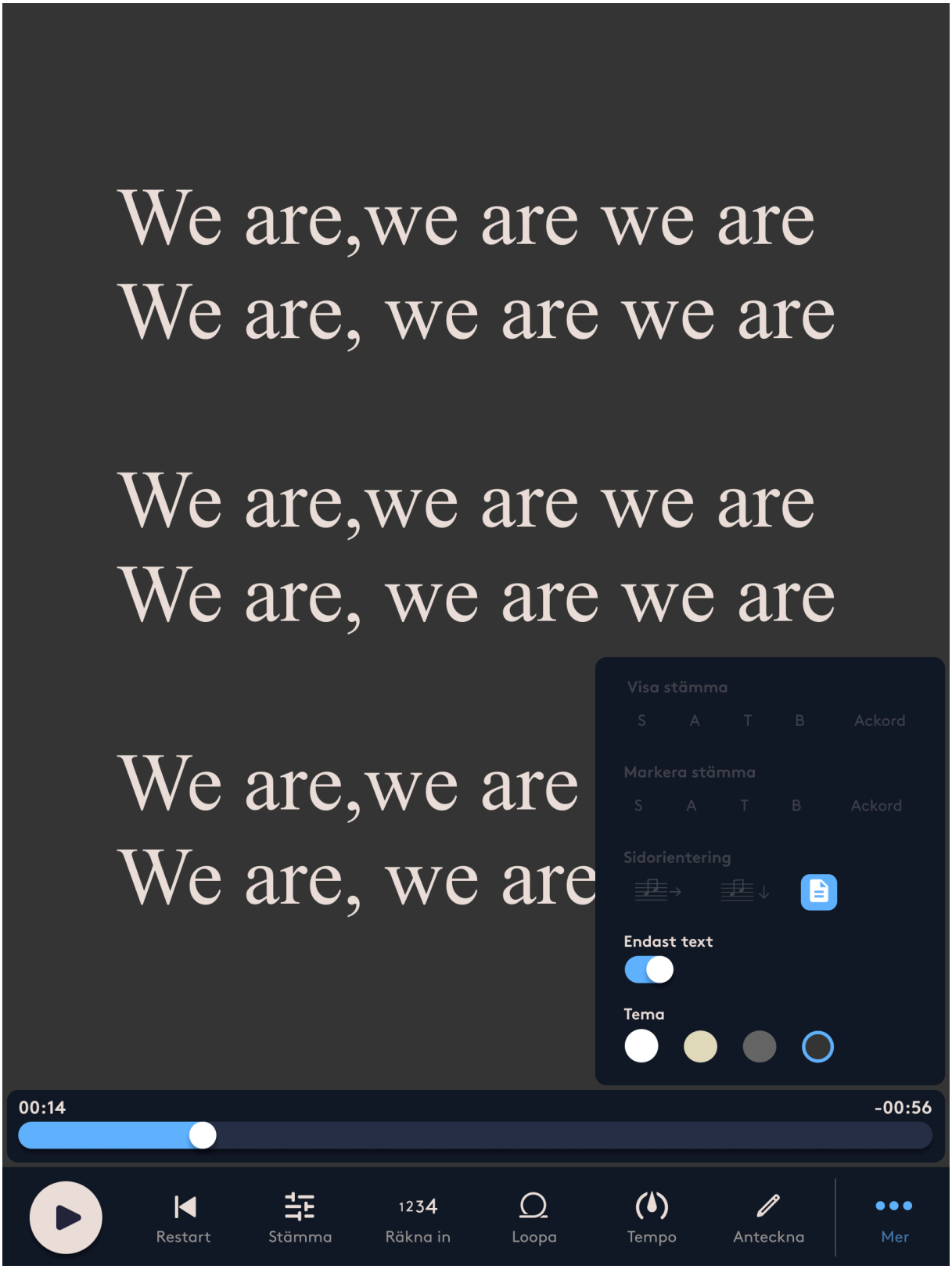


Figure 56. Practice Mode 1: Sheet Music & Audio. "Endast text" (Eng: Lyrics only) activated, showing lyrics and slider for audio.

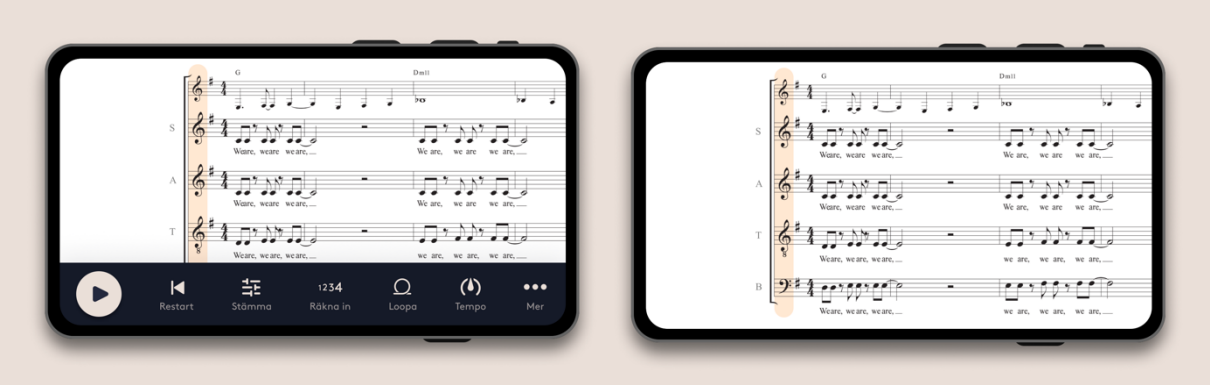


Figure 57. Practice Mode 1: Sheet Music & Audio. Displayed on phone, horizontal page orientation.

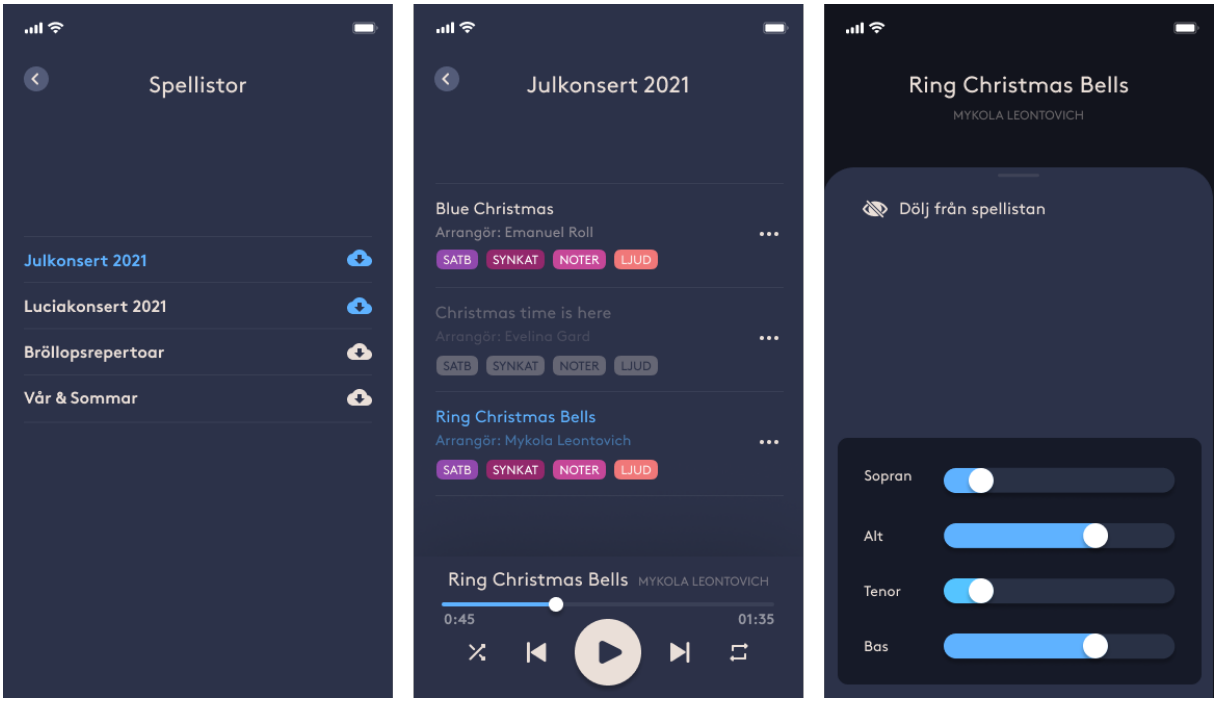


Figure 58. Practice Mode 2: Learning on the go. List of playlists with download option (left), Hidden track in playlist and media player (middle), and parts mixer for each trach (right).

Figure 59. Practice Mode 2: Learning on the go. Playing on locked screen.

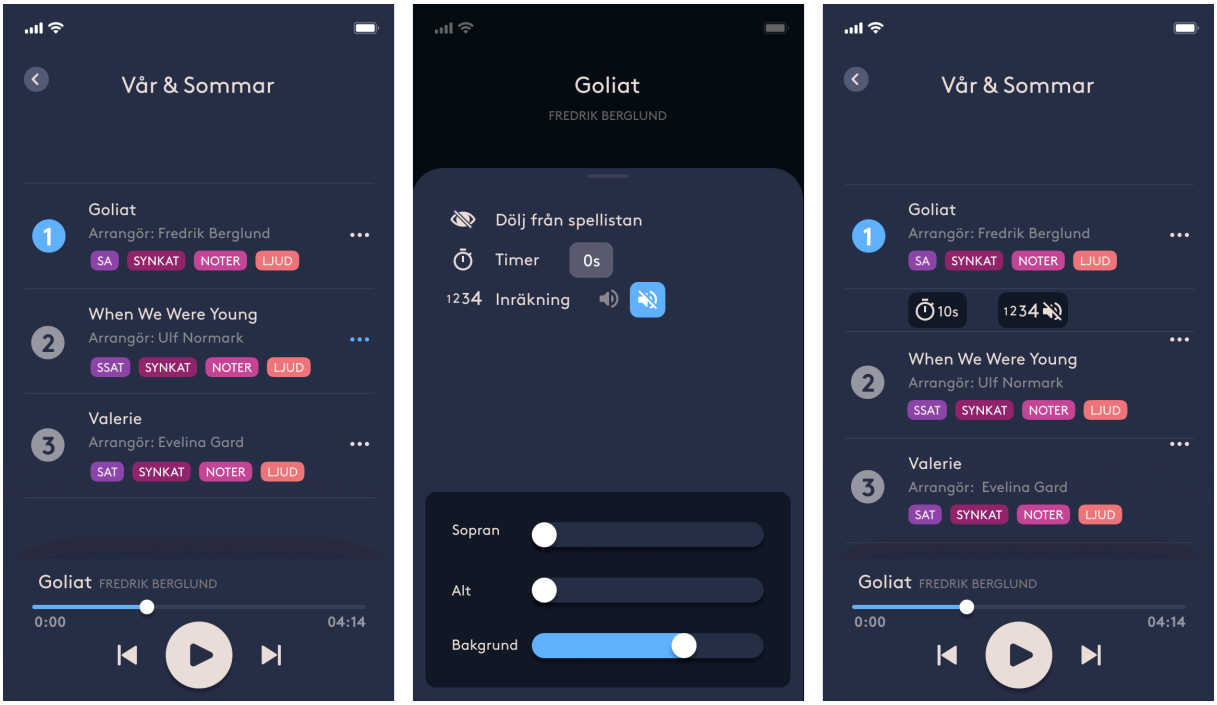


Figure 60. Concert Mode 1: Backing Track. Customizable backing track playlist for concerts, with options to change song orders(left), adjust volume of parts, hide song, timer, and count-off (middle and right).

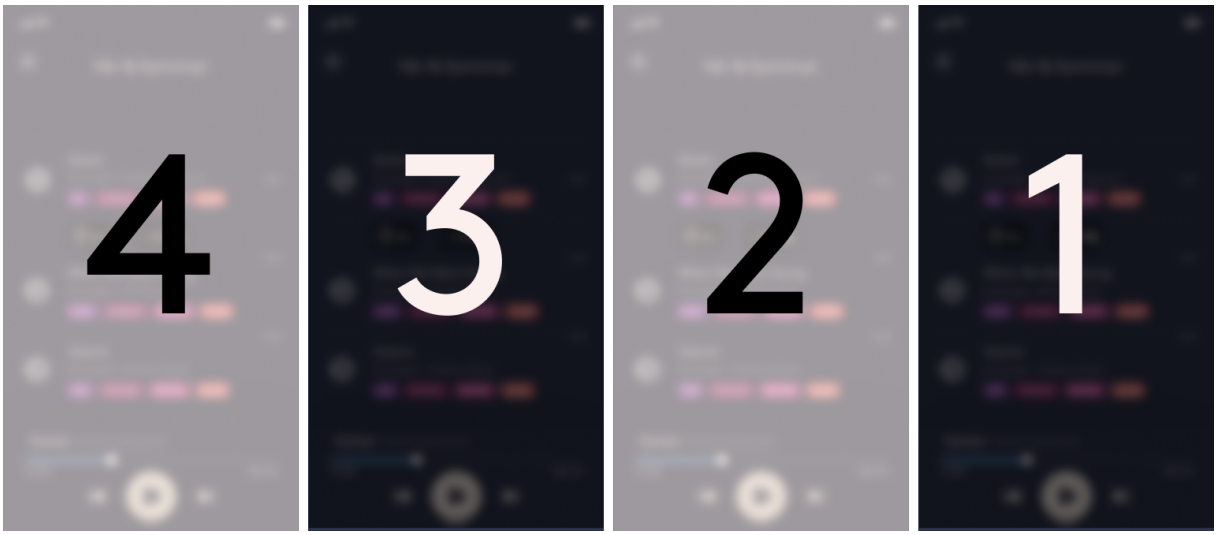


Figure 61. Concert Mode 1: Backing Track. Silent count-off function, counting one measure with flashing numbers

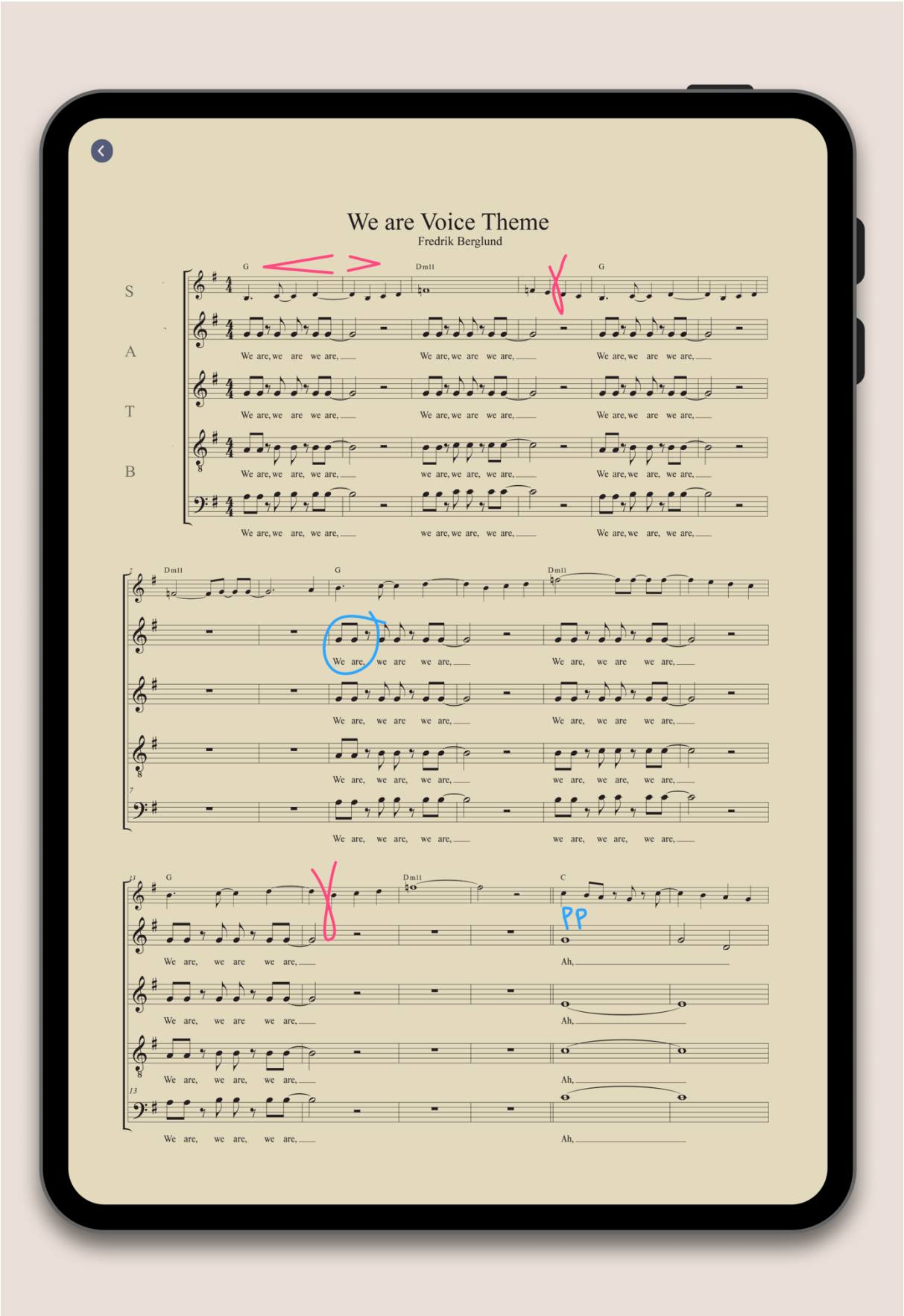


Figure 62. Concert Mode 2: Sheet Music. a view-only mode resembling paper sheet music which can easily be used during concerts when sheet music is necessary.

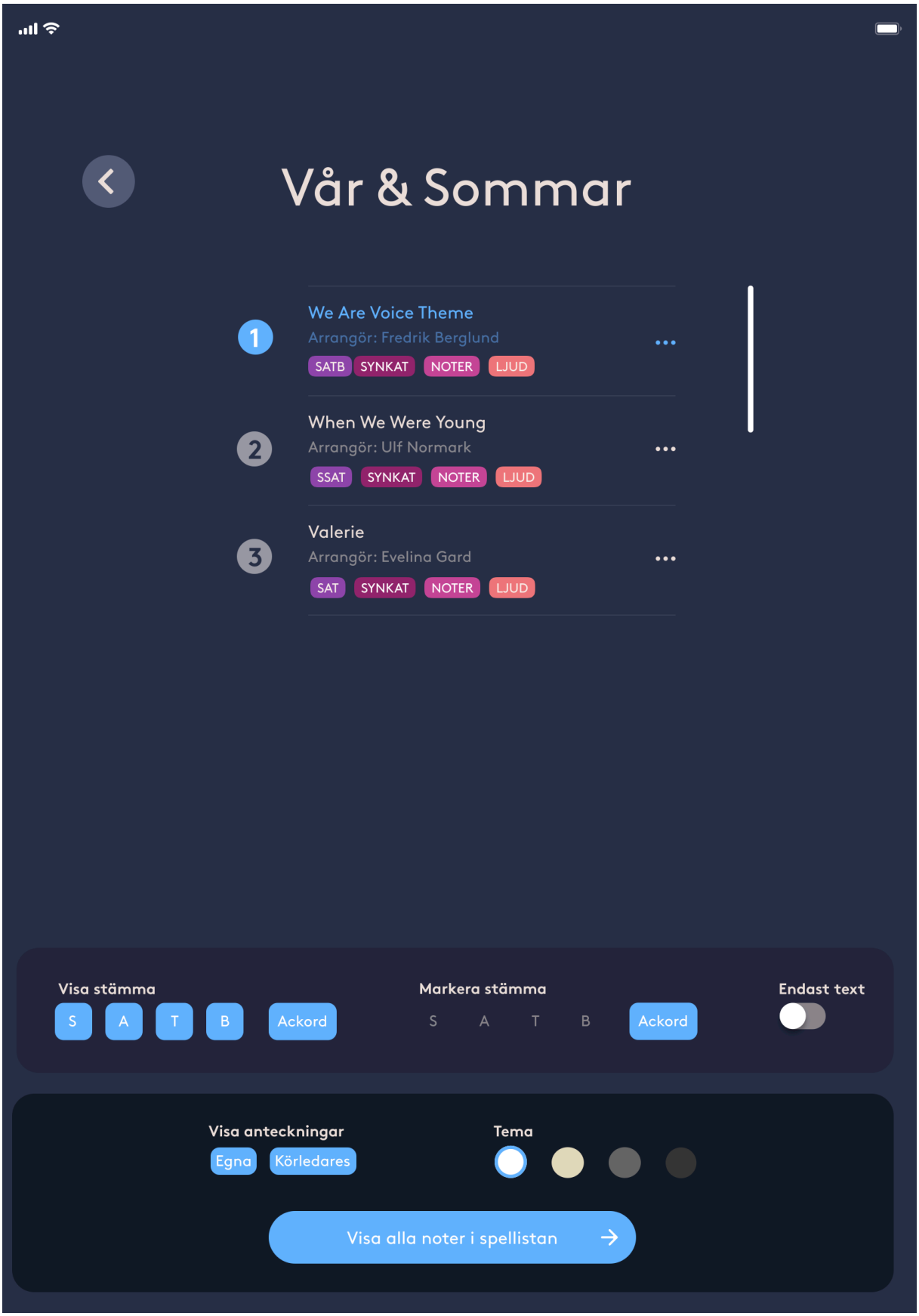


Figure 63. Concert Mode 2: Sheet Music. Menu for Concert Mode 2: Sheet Music.

8.1 PRACTICE MODE 1: SHEET MUSIC & AUDIO

Practice Mode 1 is similar to the current app, but with enhanced features (Figure 53). The intention was that old users should have a smooth transition start using this new version. Of the four different modes, this was the most complex one and could be used both for individual practice and joint rehearsal, and by all user groups.

This mode works best on tablet as this provides the best readability due to large screen size. The menu options described in the section below appears as pop-up menus above the menu list in Figure 54 (for exact placement in context, see Appendix 4a). These pop-up menus automatically collapse when the user presses play, moves the cursor, or scroll in the sheet music. There is no zoom button, but the feature is accessible through the gesture pinch. To save space, the bar showing the number of seconds into the song has also been removed, as singers mainly use the sheet music to navigate. One would not want to use this mode during a concert, as the cursor and menu takes up screen space from of the sheet music, and one may accidentally access play or other settings.

1. Play / Pause

When the user taps play, the recording is played, similar to the current design. It is also placed in the same place as before, on the far left where it is easily accessible and where the user expects to find it.

2. Restart

This feature is new, and the user can now quickly restart the piece without having to scroll. This feature is common in most types of media players and is convenient because the user often wants to restart from the beginning and practice the whole piece in one go.

3. Parts

The Parts mixer is quite similar to the current app, but with some adjustments. It is now labelled “Stämma” (Swe: Part) instead of “mixer”, which is a more common term used in the context of choir singing. All songs now have continuous sliders (in the current design, only some of the pieces in the music catalog had this option). The user can then adjust the parts’ volumes, and for example choose to hear their own part and simultaneously the other parts with lower volume, so that the musical harmony is audible. The synthetic sound is no longer available in the mixer, as it is rarely used. The mixer has also been rotated 90 degrees so that the order of the sliders from top to bottom corresponds to the order in of the parts in the system.

4. Count off

There is now a new count-off function that helps the user to get into the piece without "missing the first measure". The countdown consists of one measure counting and consists of both clicking sounds and a large orange number that appear in the middle of the screen.

5. Loop

The loop function is unchanged from the current design, except for the symbol which now is made more like loop functions symbols of other music software.

6. Tempo

Since users sometimes want to practice at a slower tempo, and sometimes want a higher tempo than the recording, it is now possible to adjust the tempo to both faster and slower. The slider snaps to the middle, 100%, so that the user easily can find the original tempo.

7. Notes

The new note taking feature allows users to take notes. The user can both undo and redo an action, as well as choose between taking notes with a pen or a thicker highlighter. The notes can also be deleted with the eraser. Furthermore, the user can choose stroke thickness, opacity, and color. The user can also choose whether the notes should be displayed or hidden. A practical feature is that choir singers can also choose to see their choir leader's notes, and thus do not miss any important musical instructions.

8. More

Under the *More* button, the user can customize the view according to personal preference. First, the user can choose which parts to display (Figure 55). For example, the altos can choose to display their part only, which saves space on the screen. It is also now possible to see chords, which means that an accompanist (as well as choir leader or vocal teacher) can now also play along with the piece.

On several occasions, however, the user needs to see the other parts. In those cases, it is better to use the *Markera stämma* (Eng: Highlight part) function (Figure 55) which highlights the part with a color, and thus makes it easier to find in row shifts.

Under page orientation (Figure 55), the first two options are the same as in the current app; vertical or horizontal view. In this new design, however, all measures are equally wide. This makes both the horizontal and vertical views easier to read when the player is running, as the cursor moves at a continuous speed instead of erratically. The readability is further enhanced in the horizontal view, since the sheet music does not automatically move upwards all visible systems have been played (unlike before, when the sheet music moved upwards after each row regardless of several systems still being visible). This minimizes the number of movements and will therefore be perceived as more restful.

The third view is new and consists of static PDF sheet music. Scrolling is done with the gestures swipe or tap on the right and left margin. Even better (recommended) is to use a Bluetooth page turner. A conductor needs the hands for conducting and can therefore turn page without obstacles.

Endast text (Eng: Lyrics only) is also a new function (Figure 56), which is useful when one has already learned the melody and only wants to practice the text. In this mode,

it is not possible to select part or page orientation. When this option is activated, a pop-up bar with a player appears, showing numbers of seconds played into the song, allowing the users to orientate themselves in the piece. The user can also choose color theme (Swe: Tema), similar to an option available in many reading apps.

Practice Mode 1 is also available on phone (Figure 57) but is simplified and does not include the note taking feature, since it would be difficult to take and read notes on the phone and also takes up space in the menu bar. The horizontal view is the optimal one for phone in this mode. Since the measures in the new design have equal width, the sheet music become easier to read as the cursor moves in a smooth and continuous manner. The cursor is placed slightly closer to the center than in the previous design, which means greater tolerance for discrepancy in synchronization between sheet music and recording. Musical notes that are slightly behind the audio should now still be visible inside the screen.

8.2 PRACTICE MODE 2: LEARNING ON THE GO

In *Practice Mode 2*, the user can practice by just listening and thus learning by ear (Figure 58). Since the player in this mode works also with a locked screen, the user can now practice when on the go (e.g., when walking or taking the bus). When the screen is locked, the name of the piece, arranger, picture, and a media player is displayed. This mode is best suited for phone, which is the easiest device to carry, but also works on tablets. For more images, see Appendix 4b.

The user can choose which playlist to practice on and download it to the local device storage. For example, if the user already knows a piece and do not need to practice it anymore, it can be hidden from the playlist, and the piece will appear gray. In the media player there are the options *Play / Pause, shuffle, repeat,* and *fast forward / backward*. One can also see how many seconds into the piece the media player is playing at. By tapping "more" during each piece, the user can adjust the part volume in the mixer.

8.3 CONCERT MODE 1: BACKING TRACK

Concert Mode 1 (Figure 60, 61) works equally well on all devices, and is supposed to be connected to a sound system at a concert.

The user selects the playlist and can adjust the song order (Figure 60) through the tap and hold gesture, and then drag and drop. For more images, see Appendix 4c.

By pressing the play button at the bottom, the playlist is started automatically from start to finish in the selected order, without pause or repeat. This is convenient for the user who arranges the concert on its own and does not have anyone who can assist by pressing play. If the user wants more control without automatic playback, one can just tap on one of the pieces in order to make it start playing, and then the next song will not start until the user taps play on a new song

Under *"Mer"* (Eng: More) the user can choose to hide a song from the playlist. By using a timer (Figure 60), the user can set how many seconds countdown each song

should have before it starts. For example, 15 seconds before the first song starts may be enough for the user to enter the stage. Between the songs, the user can, for example, have a 10-second timer to have time to wait for applause. Likewise, the user can use the count-off, as some pieces in the catalog starts immediately. In order to not disturb the audience's experience at a concert, this can be made silent and only visual (figure X).

8.4 CONCERT MODE 2: SHEET MUSIC

During the concert, sheet music is sometimes used. Even in cases where the choir sings by heart, the conductor or accompanist often needs to be able to see the sheet music. *Concert Mode 2* is therefore a concert view that works like regular paper sheet music: a static PDF view where the user turns page with the gesture swipe or tap to the left / right side (Figure 62). For accompanists and conductors who need to keep their hands free, it is strongly recommended that a Bluetooth pedal for page turn is used. Unlike the current design which only had a horizontal and vertical view, all users can now easily use the app's repertoire for joint rehearsal as well as concert. A *"back"* button is placed at the top left corner, leading back to the playlist view. This button is made small to avoid accidentally leaving the view. In Concert Mode 2, it is possible to choose to show / hide one's own notes as well as the the choir leader's notes.

Just like in Concert Mode 1, the song order can be adjusted (Figure 63). It is also possible to choose which parts are to be visible, and whether some of them should be highlighted. Chords are also included as an option, as well as only lyrics. The user also has the option to choose color theme; white, beige, gray, and dark gray. During concerts with dim lighting, the user can now choose one of the darker modes so that the audience does not see a cold light from the screen in the face of the performers, and thus maintain the atmosphere. By pressing the blue button at the bottom, "*Visa alla noter I spellistan"* (Eng: Show all sheet music from playlist), the concert mode starts, and the pieces will be presented in the chosen order. After one piece is finished, the next piece will appear as the next page, and the user does not have to click in and out of menu selections. For more images, see Appendix 4d.

9. Discussion & Conclusion

The purpose was to improve We Are Voice's digital learning tool for choir and solo singers in terms of design and user experience. The objectives were to gain insights through user studies and create a design concept that satisfies the users' needs.

9.1 METHOD

Activity Theory

Activity theory was used as a theoretical framework for understanding the activity singing and its context. It was assumed that the singer (subject) uses the app (mediating tool) with the intention of being able to perform a musical piece (object). Using activity theory generated a holistic view of the user experience and the user journey, solving user dissatisfaction due to having a too narrow scope (i.e., focusing on only the mediating tool, for example, and not the object). Furthermore, it was used to conclude that the different situations that singers encounter (individual practice, joint rehearsal, and concert) generate different user needs, but are all equally important to consider in the design. Finally, using activity theory helped in gaining a systemic view and facilitated the understanding of the purposefulness and meaningfulness of the app.

User Study

It was beneficial that the participants in the user study knew each other, since they were comfortable with both singing and discussing the topic with each other. Having strangers sing with each other could potentially lead to nervousness and performance anxiety among the participants. The user study was a mixture of several methods and proved to be beneficial and exhaustive, as it generated more useful data than the survey. The study appeared to be engaging for participants who expressed that it was a positive experience, which was likely to have increased their motivation to share their thoughts. Enactment was also a good choice of method because it made the participants reflect how they would practice and perform the pieces from the app if it would have been a real gig situation. The Instagram diary was in this context a bit redundant, as only few answers was generated this way. One possible explanation for the lower engagement might be that the participants became tired and had other commitments that made it difficult for them to practice daily. This method might have worked better over time, for example during a whole semester. Discussing and taking a stand on statements worked very well and generated many useful insights. This also made all participants feel included, not just those who were the most talkative. Co-creation was also a good choice of method because the users were quite good expressing themselves clearly this way, and thus generated great workshop material.

Survey
The survey was overall purposeful in terms of useful data, but the survey questions regarding using the app's repertoire on concert, which was maybe the most important question, remained unanswered. The answers received were scattered and, in many cases, uninterpretable. This could perhaps have been avoided with better formulated questions. Also, a few interviews with the current users could have generated better answers for this question.

Ideation & Design
It was beneficial to sketch both by hand on paper, using Miro, Affinity and Figma, since using several design media stimulated the ideation.

9.2 FINDINGS AND RESULTS

User Study & Survey
It was unexpected that 60 of the 91 survey respondents did not have a paid membership, i.e., did not have access to the functions that they were asked about (almost no features or musical pieces are available in the free version). The 31 remaining respondents is to be considered a relatively small sample, and the result could therefore be misleading.

The sample in the two user studies had quite a discrepancy in terms of demography. The user survey sample had a higher mean age, and it is unclear whether it correctly represents the true users of We Are Voice or whether people of higher age are more likely to answer the survey. In the ensemble user study, all participants were within ages 20-30 years. This was not ideal, since the samples of the user study and the survey did not quite match. Technology proficiency and eyesight (which impairs with age) are important aspects that are likely to differ between the samples. However, due to the pandemic situation and the difficulty in meeting and singing in a safe way according to government recommendations, it would have been unethical reaching out to participants of higher age. Another deficit of the ensemble user study sample was that it did not include any male singers. However, it is likely that the needs do not differ much depending on demographics such as gender and age, more important aspects are types of genres and user group (choir singer, singing teacher, conductor, solo singer, etc.).

Users primarily enjoyed singing *together*, not using an app. It emerged several times in the user studies that the use of technology could make the users feel unsocial, and a problem for those who seeks reduced screen time. Using the app should be considered as a tool for singing, not as a purpose of its own. The singing activity must always remain the focus and objective, and let the app should mainly the user learn and perform the enjoyable activity of singing with others, in order to have a truly user-centered design.

Ideation & Design
The final design proposal is a bit more complex than the previous app in terms of more features and several modes. This approach had both its strengths and

weaknesses - increased complexity could make the app more difficult to use, demanding more operations from the user before being able to execute the intended action. The advantage, however, is that the app now becomes a comprehensive tool for almost all user groups and situations who sing. In order not to make the complexity too high, it was important that each feature was carefully chosen, and if not used, exclude it from the design. The most positive outcome of the design, in comparison to the current app, is that the app now can be used in *all* situations (joint rehearsal, individual practice, concert) and by *all* users (singers, conductors, accompanists). Since user studies suggested that it was crucial for the app to work in all situations and for all users in order to be meaningful at all for choir singing, the presented design proposal is to be considered a large improvement.

The intention was to make an interactive prototype in Figma so that users who evaluate the concept could get an even better idea of how it would be like to use. However, as the concept landed in a high level of complexity to cover all user groups, there was no time for creating interactive elements within the frame of the project.

9.3 SUGGESTIONS FOR FUTURE DEVELOPMENT

As previously mentioned, some of the features presented in this design proposal (e.g., measure numbers, continuous parts sliders) already existed in some of the pieces in the music catalog, however, not in those three songs that were chosen for the user studies. It was not a conscious choice to only include pieces that lacked these features - the pieces were chosen based on the voicing (SSAA), representation from different genres, as well as including a solo song. However, this points to a problem regarding the quality of the musical content that has large consequences for the design. It is not possible to implement certain design features unless the musical content Voice contains all necessary elements and have a consistent standard. In order to give users the best possible user experience, it is therefore crucial to develop a strategy for quality control as well as criteria for the musical content being delivered to We Are Voice. That is, large variation in the quality of the musical content could harm the experience of the design.

To get better answers about how current users use the app repertoire, interviews are recommended, and it would enable follow-up questions. It is not unlikely that the current users have developed a different way of using the app than did those participating in the study, and these users might have other good ideas about improvements that was not discovered during this study.

The design needs to be evaluated both by current users who can compare with previous versions, as well as with new users. Likewise, other user groups that have not tested the app should be allowed to do so, such as singing teachers, music teachers, and accompanists.

The Bluetooth pedal page turner is a tool that would make it very easy for the user, and it is therefore recommended to somehow guide the user in the availability of this product (some users may not be aware of its existence). This can be achieved, for example, through marketing, displaying the app being used together with the pedal.

Furthermore, from a sustainability point of view, it should be investigated whether digital sheet music is better than paper. Sustainability is important from an ethical perspective but can also serve a competitive advantage that can be used in marketing. For instance, a Life Cycle Assessment could be performed.

9.4 CONCLUSION

Choir singing and solo singing are social activities that include many different user groups and situations. The needs differ depending on whether you are a choir singer, solo singer, conductor, singing teacher, accompanist, or audience. The needs also differ depending on the context in which you sing; individual practice, joint rehearsal or concert. A choir singing app, in order to be perceived as purposeful to users, must work in *all* above-mentioned situations. Likewise, practice and language differ somewhat depending on level of proficiency and genre. It is possible to provide a service for all groups and situations, even if it slightly increases the complexity of the app in comparison with an app for a narrower target group.

The most common substitutes for the app are paper sheet music and recordings, options that are cheap and easy to use. These substitute products work well for all situations (joint rehearsal, individual practice, concert) as well as all users (singers, conductors, accompanists). An app that is to be preferred by the users must work for all situations and users, and thus 1) provide *the same important functions as paper sheet music*, and 2) provide *higher value than paper sheet music*. The design proposal presented in this thesis is likely to work for *all* important situations and users, as well as achieving both (1) and (2), which is believed to be the most positive outcome of this project.

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Appendices

1. GANTT CHART
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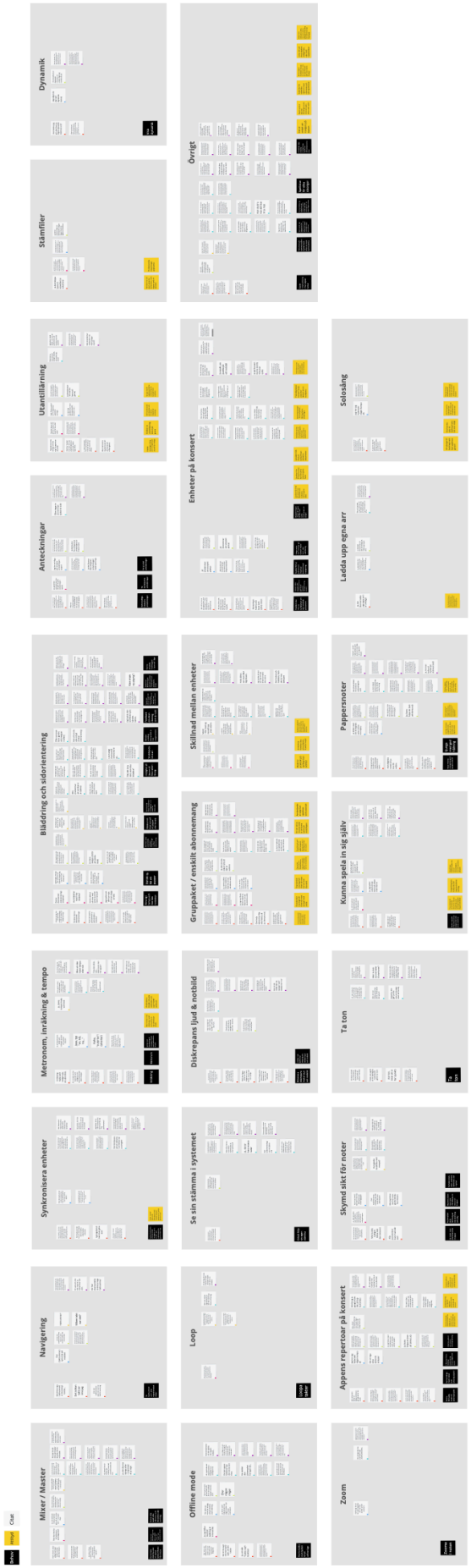
APPENDIX 1

Gantt Chart

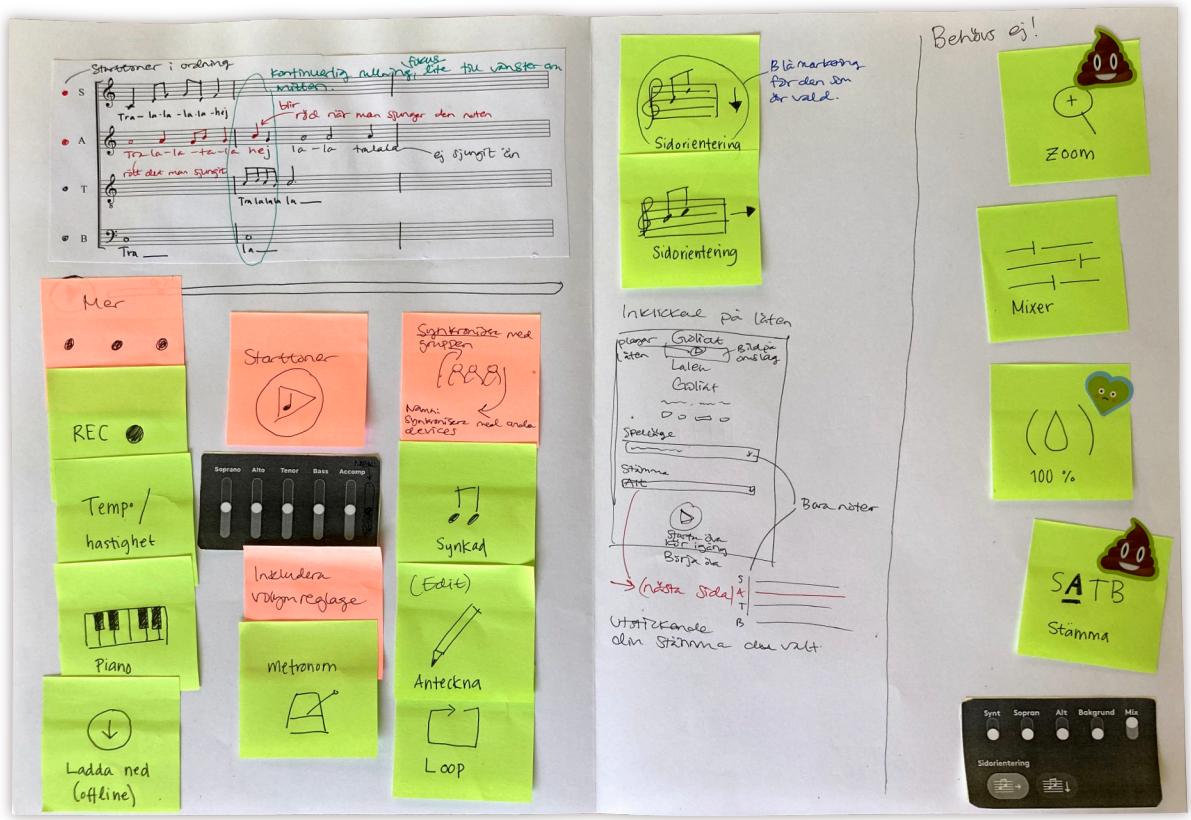
APPENDIX 2

KJ-analysis



APPENDIX 3

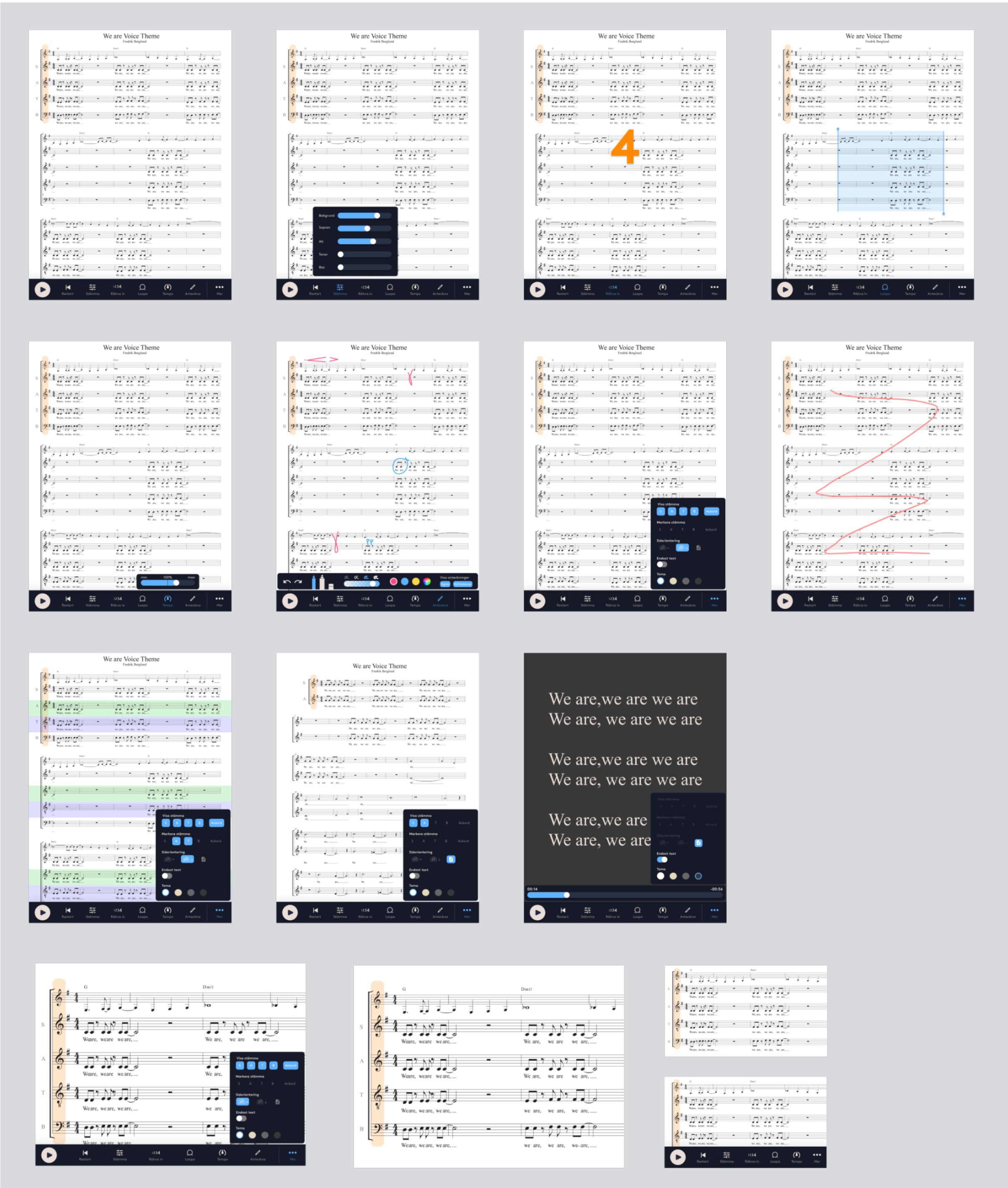
Co-creation results



APPENDIX 4a

Practice Mode 1

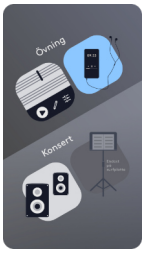
Sheet Music & Audio

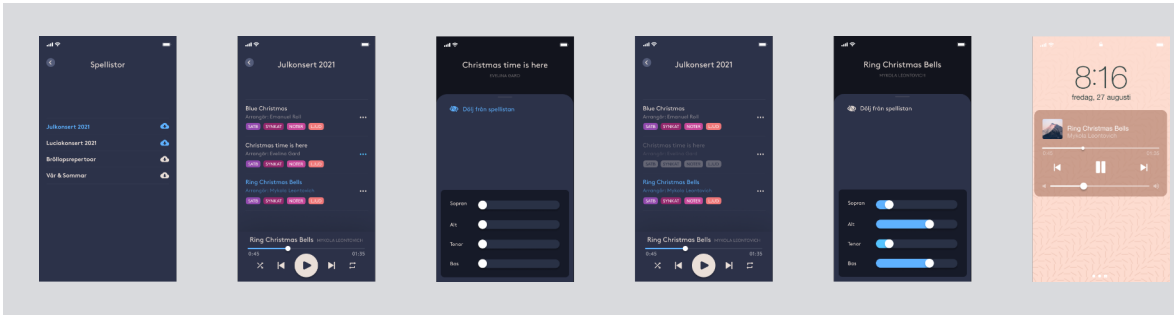


APPENDIX 4b

Practice Mode 2

Learning on the go

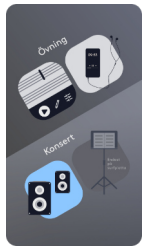


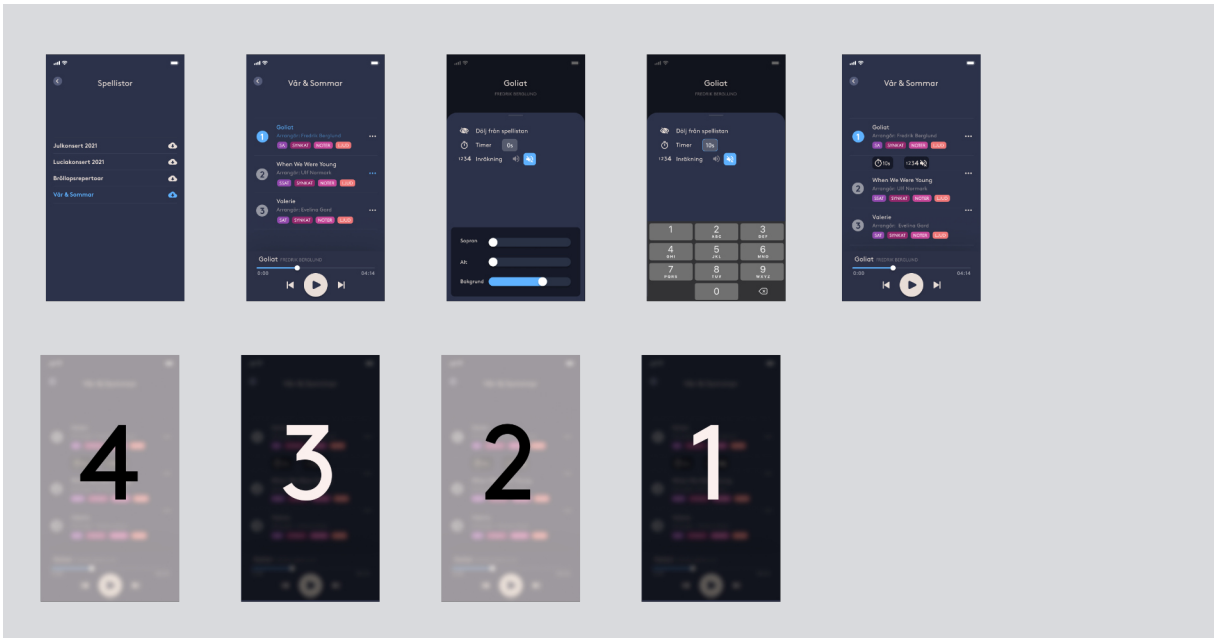


APPENDIX 4c

Concert Mode 1

Backing track

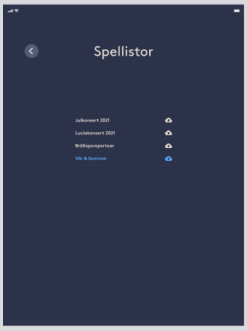


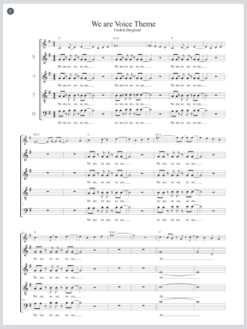


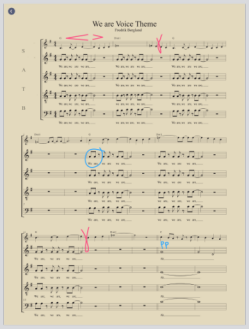
APPENDIX 4d

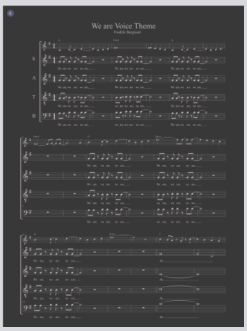
Concert Mode 2

Sheet Music









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