

# Experiments Logbook

## Mics

### Session 1 with Tomasso Rolff:

1 November 2023

This first session was done together with Tomasso Rolff, first year Art of Sound student at the Royal Conservatoire. He recommended I first try with Piezzo pick-ups.

We're using an acoustic harp, guitar amplifier and a piezo pickup.

The goal of this experiment is to decide which position of the piezo on the harp works best to amplify and gives the best sound. This will be tested by placing the piezo in different places on the harp, and evaluating the effect it has on the sound when playing certain strings. The requirements are that it is precise, string-wise but at least in a register.

Our first try is to find out if a piezo can pick up an individual string. Because if this is the case then we would just buy 47 of them for each individual string.

The sound is definitely the loudest of the string it is right next to, but the piezo does pick up the sound of the other strings up until a certain register.

We tried it on the soundboard, closer and further away from the string. The closer to the string, the more accurate it is for that particular string.

Then we tried it inside the soundbox. This is what you see in the kits you build into your harp. Still the same thing happened: selective for a register, but not for an individual string.

Tommy fixed it inside the soundboard between F7 and G7 (lowest, as shown in figure 2) and then tried different strings in the different octaves, first C's then F's. So same pitch different octaves. They are sort of equal but the closer to where the pickup is it gets a bit louder.

Putting the piezo on the soundboard gave a dryer sound than inside the soundboard. Inside the soundboard picks up more from the other registers than on the soundboard, so it's less precise. This is because inside the soundbox, the string creates sound, and it vibrates more even after the string has been played.

Next, we tried placing the piezo on the soundboard but against the bridge of the string. This seemed to pick up a more precise sound from the actual string.

If you put the piezo against the string it buzzes with the metal. This was mostly on the metal strings. This creates a sort of more rough sound. This is a very cool effect, and it picks up more of the individual string but in the end we would want the initial amplification to be a clean sound without effects. We found this effect happened when you place it from above against the string, as shown in the figure below:

On the back of the soundbox but still outside it gave a very nasal sound.

As an experiment to try to work with registers, we tried to mount the piezo to a drumstick which we placed against the string. This drumstick obviously has an effect on the strings, but it is to test how the sound acts if it goes through a medium and if we can that way use a predetermined length to only pick up the strings within that length and so register.

It seemed like a good idea to isolate the groups, but it cannot really isolate so much. This sort of defies the purpose, so we will not be using this.

The most detailed one we got after several experiments was on the bridge between the strings outside of the soundbox. It is most precise but still natural, as long as piezo is not touching the

string where it's actually vibrating, so from below not from the top on the string. This is shown in the figure below:

It still picks up the other registers but not so much that we wouldn't be able to cancel out the frequencies.

Lyon Healy, like the harp we tried it on initially, has buttons at the bridge for the eye of the string, from the registers where there is gut (so excluding the basses). This makes it hard to place the piezo against the string from above like we liked. So, we also tried it on a Salvi, like the harp that I have, which doesn't have those buttons. When it's played as touching the string for the below, our findings were the same as on the basses on the Lyon. It's easy to place it against the string and has a desirable sound.

With this position, we could really hear a difference in registers when we tried canceling them out. There is some bleeding between the sections. This is good in general because it enhances the timbre of the overall sound. But at the same time, it is possible to cut and filter the sections so that there will not be bleeding between sections when you don't want it. This is a condition for the stellar sonata.

This is what it sounded like to play after our first experiment:

(insert video)

We have some work to do in perfecting the sound, but I wanted to include this video as part of the results of experiment 1.

So, it seems like we would be doing something more closely to what Camac and also Salvi on their electro acoustic harps. They have pickups on each string on the bridge on the soundboard. Rather than the kits you can put inside. The sound is still very metallic, and it's not precise so far splitting registers.

Based on our findings, we want to 4 piezos, for bass middle and high and one in the chamber (sound box).

In the next experiment we would work on refining the sound, placing all 4 piezo pieces on the harp, and working on the creation of the split registers.

The other harps in the room were sometimes interfering with our experiment. For the next experiment we would want to be in an isolated room like one of the art of sound studios.

## **Session 2 with Tomasso Rolff:**

12 November 2023

We're using an acoustic harp, 4 piezo pick-ups (new ones that we ordered so maybe slightly different results), an amplifier. Today we're in one of the Art of Sound studios to make sure we have a soundproof space to work with.

The goal of today's experiment is first of all to test these new piezos. They already don't seem to fit between the strings, so we have to pick one of the other options, or take off the plastic protection cap.

Furthermore to make sure that each piezo only picks up a certain register as to not have the resonance of the others.

So first of all, we tried to redetermine the position with the new piezos.

We tried with and without the capsules on it. Without had a very normal sound, slightly metallic-y and a bit dry because it is amplified but quite normal hard sound. With the capsule the sound sounded damped and just not nice in general. So we decided to remove the capsules from the piezos.

Then for the position we tried to record the same passage with 2 piezos, one on the soundboard and the other between the strings. The one on the sound board had a slightly clearer sound. The one in between the strings picked up more of the actual register it was in, in this case the basses. We decided it therefore be best to use on the basses a piezo in between the strings to use for the distortion, and for the other registers we would stick the piezos on the soundboard to make sure we have a nicer sound quality.

The sound on the basses for the distortion sounds amazing! The piezo is starting to take shape.

Now the next step is to figure out how to stop the bleeding from other registers.

First, we just tried to fix the registers a bit with the piezos as we had them, just 2 one between the strings and one on the soundboard but low. After fixing some settings in Pro-Q, there was less bleeding between the registers, but it was not completely fixed just yet.

So, we tried with another piezo for the high register. Tommy thought that we could maybe use the sound of that one to cancel it out in the pick-up of the bass one. Counterphase.

Inside the soundbox for the high register captured too many things outside of the register, resonance wise, so we decided to stick to the piezo on the soundboard technique we have been using.

We had to make some changes because of the cable, which couldn't be against the soundboard because it interfered with the vibration but also for it to not be in the way when played both strings and pedals. In the end we found a solution for it, and it looks like this:

We thought maybe the one on the bridge for the basses kind of picked up the whole fret so maybe we needed to change it in the end. We put it on the soundboard but inside the soundbox.

We tried it with some effects like distortion and echo (warehouse)

Conclusions of the experiment. The positions of the 4 piezos have been decided. The sound quality is therefore a lot better than the first time.

Already some work has been done for the splitting of the registers, but it is not completely working yet. Next time we will work on perfecting it more. We thought maybe it was a good idea to meet with my brother Max Frimout. He has worked on splitting registers before, and he might be able to help in further perfecting it. So that is our idea for next time.

Regardless of the register splitting, I still don't really enjoy the sound that the piezos create. It sounds metallic and flat. There's not much of the natural resonance of the harp left. The sound can be a bit sharp. This is also something I want to experiment more with in the future, to improve the sound of the amplification.

## **14 February 2024: Meeting with Max Frimout**

I met with my brother Max Frimout to talk about my research on the harp and electronics, in particular the amplification of an acoustic harp which I've been working on. I proposed to him the problem of the bleeding of registers when you place microphones on an acoustic harp. I asked him what his thoughts were and what tips he had to help me further. He said that with placing microphones on a harp, because of the large amount of resonance of the chamber of the harp, the microphones would always be able to pick up sounds from the other registers. The harp is, after all, one large sound box in which the notes resonate for what sometimes seems to be eternity. It is the nature of the harp, it is what differentiates it from other instruments. It is what makes the harp special, but also what can pose as a difficulty for harpists, particularly in certain repertoire.

So there's 2 options really, either you build a software that uses pitch recognition to split the registers, but that means you would basically be building an electronic harp, not just electro-acoustic, but really a MIDI harp, which would be more similar in a way to a keyboard, than to a harp, on which you can change the sounds and desired effects. Is that something I would want to do, or am even capable of? For me that seems to derail too much from my initial research.

So the other option is to use the frequency of pitches to cancel out registers using a program like Ableton, which is actually the program I need for the effects of the Stellar Sonata and am currently learning to use. I think that this seems like the most achievable option for me. It may not be as perfect as an electro-acoustic harp that's built for these sorts of things, but I can try to come as close as possible.

## **Session with Firtina Kiral:**

1 March 2024

In this experiment, the goal was to cancel out registers on an amplified acoustic harp, using 2 piezo pick-ups, a sound system (amplification), an audio interface and Ableton. For this I had the help of Firtina Kiral, since he is experienced with the Ableton program. To process the sound in a program like ableton, you need an audio interface, which I have recently acquired. A present from my father to support my academic research. We mic-ed up the harp and recorded a few fragments of the Stellar Sonata, using the same mic placement as experiment 2, with and without the frequency cancelation as my brother had suggested.

Conclusion: it was already a lot better but I can still hear the effects of the distortion seep through to the higher register. it's an improvement but the search continues.

## **1 March 2024: Meeting Alba Calva**

Later that same afternoon I met with Alba. Alba is a dear friend of mine, so our meeting was initially not related to our research. However, the topic of her research came up, since she is a second year master student and just finished her research by handing it in only yesterday. We had never really talked about what we are both working on, miraculously, but to our great surprises it seemed to be rather close in topic. see , where I'm attempting to recreate an electro-acoustic harp as a cheaper version with microphones and an acoustic harp to serve my needs, Alba is recreating a MIDI harp as a cheaper version with microphones to serve her needs.

As mentioned earlier, a MIDI harp is a harp that is similar to a harp as a keyboard is to a piano: the format is the same, keys, or in the MIDI harp's case strings, but the sound that it produces can be changed. Here again, a MIDI-harp is incredibly expensive, so Alba has been working on creating an algorithmic software that can recognize the pitch that has been played on an acoustic harp with a microphone, and changes it through the software into the desired sound or effect but of the same pitch, and sends that sound over the speakers or amplification. She has been building, for the past 2 years, the software my brother mentioned I might need to build in order to perfectly cancel out registers.

So upon this occasion, Alba let me try it out. [\(there's a video of this\)](#)

Although her work is quite obviously amazing, it is still quite premature. I can change the sounds of the harp in whichever sound you want, but usually it only works well when one note is being played at a time. When you play the harp as you might normally would, the software doesn't react fast enough yet. It doesn't catch the pitches and fails to transcribe them into the desired sound. For Alba's desires and wishes, this doesn't necessarily state a problem yet, but for mine right now it does. I'm very happy to have gotten to try it out and of course it is always great to know your field and know what your fellow musicians are working on. We will keep each other updated and in mind. She's going to keep developing her software so who knows what values it will give in the future. In the meantime I will keep following the path that I'm currently on for my research.

# Effects

## Session 1 with Cláudio Pereira

30 april 2024

With the help of alumni Sonology student Cláudio Pereira.

We used an acoustic harp, a piezo pick-up, speakers/amplification, an audio interface and a laptop with ableton. The goals of this experiment was to start building the effects into ableton, using the values and settings given in the preface of the Stellar Sonata by Caroline Lizotte, the composer herself.

I asked Cláudio to help me with this, because he is experienced with Ableton and has studied sonology, focussing himself on sound design as an artist. I believe that he would best be able to understand my wishes when talking about the particular sounds that I desire for the different effects.

We set everything up to amplify the harp. Then we created the first effect into ableton, which was the distortion. To my surprise, and slight disappointment, it doesn't necessarily work to just create the effect and fill in the values exactly as it was on paper. The values written by Lizotte were created for the Camac Big Blue electro-acoustic harp, whereas I'm working with a normal acoustic harp and microphones. The material that's being used is different, so the values of the effects will be different. Cláudio knew this of course, so this experiment was purely to make me realize that. What I learned from Cláudio is that the values to fill in for the effects on Ableton depend on the following factors:

The microphones: whether it's the pick-ups of the electro-acoustic harp, a piezo pick-up or another contact mic, each material is different and so will influence the sound that comes out. To achieve the desired sound, the values within ableton and on the audio interface, both input and output, will have to be adjusted accordingly.

The soundsystem(amplification): which sound system is being used also influences what the settings of the effects and the audio interface will have to be. A smaller sound-system of lower quality can be more easily overstimulated whereas a larger one, of higher quality may have many more nuances to the sound that couldn't be heard before.

In the coming weeks I got to experience these factors for myself, mostly for the sound system that is. In order to gain experience setting up my set-up for an amplified harp, I practiced in different locations: at home with headphones, in the music studio of my parents with 2 different sets of speakers, large and medium of good quality, in the rooms of school with medium sized but good quality speakers, and finally in studio 5 with larger sized speakers, of good quality.



Each time I performed excerpts of the stellar sonata, I had to change the values on the audio interface as well as within ableton slightly to come slightly close to the desired effect.

At the end of these try out sessions I had 2 effects ready: the 'space-echo'; a slight reverb on the original harp sound, almost like in a church, and the distortion; with our best attempt of it being only on the bases.

At the end of this first session with Cláudio I told him that I'm not very happy with the quality of the sound that the piezo's are able to produce. He suggested to try out an AKG contact mic, which they lend out at EWP. so the next session will be focused on the difference in sound of the piezo and the contact mic.

1 may has important info that supports what is described in experiment 4/ session 1 with cp

# Mics but also effects

## Session 2 with Cláudio Pereira

25 May 2024

With the help of alumni Sonology student Cláudio Pereira.

We used an acoustic harp, a piezo pick-up, a AKG contact microphone, speakers/amplification, an audio interface and a laptop with ableton. The goal of this experiment was to compare the difference in sound that is produced when an acoustic harp is amplified, comparing a piezo pick-up with a AKG contact microphone. All of this has the aim to show the best result in sound. the 'best' being defined by personal taste as well as art of sound theories, as being closest to the sound of the Camac Big Blue electro-acoustic harp. This is because that's what the Stellar Sonata was written for. This is the motivator of the research because that is the piece I want to play, so that's what I'm attempting to recreate. Furthermore, this experiment also describes the best placement for the AKG Contact Microphone.

The experiment started out with us recording the same bit of music with a piezo pick-up, and then with the contact mic. Listening back to the fragments, the difference to the sound was almost laughable. The piezo didn't stand a chance against the contact microphone. Of course, the difference can already be noticed in the price difference: a piezo is generally only 5 euros and the AKG contact mic costs around 150 euros. But I must say that the sound quality difference is immense, and for me definitely worth it. The sound with the contact mic is more natural, more true to the character of the harp. In [the following recordings](#), the difference can already be heard:

On top of this, the contact mic appeared to be more precise in its pick-up of the sound, which means that using 2 might allow us to split the registers of the harp even better.

For the placement of the mics, we tried out some different spots for the contact mic, as I had done before with the piezo. We tried inside as well as outside on the soundbox and on different heights of the soundboard. The best sound, again as a personal view using art of sound theories as well as the ideal of the electro-acoustic harp by Camac, appears to be on the outside of the soundbox. We placed it on the left side, in the lower register, between the transition of the 3rd and 4th octave. This is the register of the harp that has more trouble coming out in sound at it is where the cut for splitting the registers has to be made. When one places the microphone here, it serves as a continuation of the natural sound of the harp, where the harp resonates itself. In an earlier experiment, I spoke of the harp being a difficult instrument to amplify because of its large amount of resonance. Especially inside the soundbox, the sounds can get mixed up and create confusion for effects and splitting registers. Even regardless of amplification, the large amount of resonance can create problems in certain repertoire for harpists. I believe that with the

outside position of the microphones, we are using this resonance nature to our advantage. We are using it to create the most natural and warm sound, since sometimes microphones can make the harp sound flat and metallic, while not interfering too much with its own frequencies.

We mixed the sound to be partially the amplification of the harp as well as the natural sound.

In order to further elaborate the difference, I later prepared a case study. (still make more elaborate!!!) This case study shows excerpts from each of the movements of the Stellar Sonata, with and without effects, on an acoustic harp, and electro-acoustic harp, an acoustic harp with mics built-in the **soundboard** and an amplified acoustic harp.

Conclusion:

With the contact mic a much more natural sound of the harp can be achieved when amplifying. The sound is much cleaner than that produced with a piezo pick-up. It comes much closer to the sound of the electro-acoustic harp.

I'm quite satisfied with the progress that we're making. The chapter on harp amplification is starting to come to a close, with only the experiment of 2 AKG mics left, so the next step allows me to experiment further on the recreation of the effects, the ableton presets.

# Effects

## Solo session:

1 June 2024

I used an acoustic harp with a set of microphones built in (by Dusty Strings), speakers/amplification, an audio interface and a laptop with Ableton.

The goal of this experiment was to further shape the different Ableton preset effects, adding a new effect to the list, and see the difference in sound with this harp with built-in microphones

The microphone set that is inside this harp is different than the AKG contact microphones. First off, they're a different brand of microphones so the quality of the sound might change. Then there's 4 microphones, not 1 or 2, and they're glued on the inside of the soundbox against the soundboard. Then there's a jackable pug-in at the bottom of the harp. It's a handy construction for amplifying the harp, since the microphones are hidden, and only 1 cable has to come out at the bottom back of the harp. The downside is that the microphones are stationary; they're glued in so cannot be moved, which means that changing them according to my wishes is not an option. I have found throughout my experiments that I prefer the microphones to be on the soundboard on the outside of the harp, for the most natural sound. Since moving the position of the microphones is not an option for this set, it serves me less in the purpose of best sound quality, as well as for the possibility of spitting the registers more precisely.

Regardless of that, this session was useful for me because I got to work on the different effects. Yes, the microphones were different than what I would normally use, and also the sound system, which means that the values of the Ableton presets will have to be adjusted again later, but it was interesting to see how the previously created effect reacted initially, and how they needed to be changed to achieve something of a similar sound. And I had the opportunity to create the presets for 2 more effects. Below I will explain per effect what I have been working on so far.

### The Reverb:

A relatively simple reverb that is quite similar to the original harp sound but adds reverb, as though the harp were played inside a big church. Often a reverb is referred to as making a 'a series of audible reflections' 'the sound that reaches us a few milliseconds after the direct sound'. <https://www.musicradar.com/tuition/tech/a-brief-history-of-reverb-602421> and <https://www.premiumbeat.com/blog/what-is-reverb/#:~:text=Reverb%20produces%20early%20reflections%2C%20the,the%20space%20is%20much%20larger.>

This effect was already created in the previous experiment, experiment 5, together with Cláudio Pereira.

It is used throughout the whole first movement of the Stellar Sonata, as well as the beginning of the 2nd movement.

Since the sound of the reverb reminds me so much of playing in a church, it brought me to an idea. What music has been played more inside churches over the years than Bach? Currently, besides my research I'm working on the English Suite No2 by JS Bach together with my main subject teacher Sylvain Blassel. There's something religious and Holy about Bach's music. Furthermore, for me personally, in the 4th movement of the english suite, the Sarabande, I get the undeniable feeling of floating. The notes seem to be floating in the air, out in the space, the attack only as though a twinkling star. So that brought me to an idea. To play this movement of the Suite with the reverb effect. Especially when it is played not too past, there just seems to be so much space in the music. I think this is a great start for experimenting what new things can be created with the harp and electronics, to combine something old with something new, the harp with electronics, Bach with effects.

The Distortion:

This effect was created during experiment 4, when working with Cláudio Pereira, and has been shaped more and more with each experiment.

This effect comes into play in the middle of the second movement of the Stellar Sonata. It has been a tricky effect to create, I found it usually didn't really work, it didn't come close to the sound I wanted to create, which I compared to recordings of Caroline Lizotte playing the Stellar Sonata. The Distortion of Lizotte sounded 'heavier' as so to say. Today in the experiment, I found out that this was due to the fact that I wasn't sending enough bass through the effect. I had been trying to just duplicate the given values as they are written in the technical recipe of the Stellar Sonata. This recipe has been made for the electro-acoustic harp, which has a split in the register, with the possibility to let the basses function separately from the middle and high register. This was previously explained and is hence why I have been working on splitting the registers. The distortion effect is in Caroline Lizotte's set-up, programmed to be sent over the basses. Because of this, the Ableton preset itself has a very low value for the bass and thus barely sends any bass through it. Since I don't have this option of sending the effect over the basses only, I had to increase the value of the bass on the distortion effect a significant amount. This finding allowed me to give much more definition to the effect, and I feel that after this session it comes much closer to the sound that can be heard from the composer's recordings. I still feel like sometimes the effect is over-triggered. It sounds like a rumble but the pitch that was played to trigger the effect, gets lost sometimes. I would like to fine-tune this effect a bit more to be more closely related to the pitch of the bass played.

(I think I made some recordings of this in-between step? Include here compared with a passage from caroline as comparison)

The Flanger:

This effect works by mixing two copies of the same audio signal, where one copy is slightly delayed, usually less than 20 milliseconds, with the delay gradually changing period.

Find better source but for now wikipedia:

**Flanging** /'flændʒɪŋ/ is an **audio effect** produced by mixing two identical **signals** together, one signal delayed by a small and (usually) gradually changing period, usually smaller than 20 **milliseconds**. This produces a swept **comb filter** effect: peaks and notches are produced in the resulting **frequency spectrum**, related to each other in a linear **harmonic series**. Varying the time delay causes these to sweep up and down the frequency spectrum. A **flanger** is an **effects unit** that creates this effect.

'The flanger is a dramatic effect that was first derived in the 60s by recording a song on two tape recorders at the same time, then slowing down one of them by placing your finger on the tape flange'

<https://www.uaudio.com/blog/modulation-effects-basics/#:~:text=The%20flanger%20is%20a%20dramatic,first%20hit%20songs%20that%20it>

There's different sorts of Flanger effects, that vary in their delay, period, and frequency, all giving different results for the sound. In the case of the Stellar Sonata, I used the recording by Caroline Lizotte, the composer herself as a reference. In the piece, the effect can sound almost like the noise of a whale, and Lizotte described it to the character of Bachus, the brother of Ariane, which is the focus of the methodology of the story behind the piece.

The effect is used in the Second movement, starting just after the intro, and coming back after the distortion part for the ending of the movement.

I created this Ableton Preset today, and played around with the values a bit until I got the effect that I wanted. It will still have to be perfected, and the values will obviously change a bit when I change the sound system and return to the AKG microphones, but I'm quite satisfied with how it is sounding so far.

It's a super fun effect to play around with and has loads of possibilities. It's also fun for Bach's Sarabande, but I think maybe it's a bit much, so for now I will stick to the Reverb for that. But I definitely see possibilities for future exploration for new repertoire.

The Delay:

This effect repeats the input milliseconds after it is played for multiple times until it dies out.

A similar sort of effect is used in the middle of the Third movement of the Stellar Sonata.

This Ableton Preset I for now created not to reproduce that effect but more to play around with and invite for creativity of creation.

It was fun to play around with it and improvise a bit. I discovered some cool effects when tapping on the soundboard, ([video](#)) and played the isolated harmonies of Bach's Sarabande.

Conclusion:

The values of the Ableton presets changed because of the material being used. The signals and inputs are different so that changes how Ableton needs to manipulate the harp sound, in order to

achieve the same result. So it is influenced by: microphones, sound system and the set-up of the technical board as well.

With this experiment, the effects for the first 2 movements are complete. They might be open for further sophistication but for now they have been understood and created.

## **9 june 2024: solo session**

Session in 5.11 in the KC.

I used an acoustic harp, a AKG contact microphone, speakers/amplification, an audio interface and a laptop with ableton. The goal of this session was to fine-tune the Ableton Pre-sets that I worked on in Experiment 6, to suit the AKG mics and the sound system in 5.11.

For the Distortion and the Flanger I needed to change the values. They were too soft initially, the effect wasn't sounding enough, not obvious enough. I experimented by changing one Parameter at a time to see how it influenced the sound. I did this until I achieved the sound that I liked.

The Flanger I personally really like, but if we're judging it in comparison to the composer's effect, it doesn't sound the same yet. She uses an old device called the Line 6 for this Flanger effect, whereas I use it through Ableton, so even a standard preset would be different. I think this may be why I definitely don't have much use for the values in the Technical Recipe in this case.

I got a bit stuck on this during this session. I wasn't sure how to fix this by myself, since I didn't fully understand the character of the Flanger effect in Ableton yet. So this will be one of the questions I have for Cláudio during our next experiment.



### Session 3 with Cláudio Pereira

25 June 2024

With the help of alumni Sonology student Cláudio Pereira.

We used an acoustic harp, 2 AKG contact microphones, speakers/amplification, an audio interface and a laptop with Ableton. This experiment was conducted in Studio 4, in order to have a better quality sound system. The goal of this experiment was to experience the difference when using 2 microphones instead of only 1 as far as the sound quality and the possibility of cleanly splitting the bass register from the middle and high register. Besides this, during this session we worked on improving the behavior of the Flanger to be more closely like the Flanger of the composer.

We created the same set-up as before, first with only one microphone, Mic1, positioned as described in Experiment 5, on the left side of the soundboard, outside the soundbox, placed next to the lower register. We adjusted the values of the Ableton Presets accordingly, to fit the soundsystem in Studio 4.

Then we placed another microphone, Mic2, this time on the right side of the soundboard, much higher than the first, close to the middle and high register of the harp. (maybe include pictures?)

What we found from this was that it became easier to balance the sound of the harp. By turning up the volume of Mic1, we heard more basses, whereas turning up the volume of Mic2 resulted in more middle and high register. This is a handy trick in general in harp amplification, because the lower register has more trouble to come out on a harp. The placement of the microphones like this can aid in this obstacle.

Furthermore, it is an important finding for me when placing with the distortion effect of the Stellar Sonata, since that effect is only meant to affect the basses of the harp.

For the Distortion, we put this effect only on the Mic1 input in Ableton. On the Mic2 input we used only the reverb effect. It made the distortion more closely related to the pitch of the bass that was played. Before I think the pitches of the upper registers were interfering too much still, creating a confused rumbling sound. Before the distortion seemed to react mostly percussive, to the pluck of the string rather than the note being played, whereas now it's still percussive but it has more of the original pitch sound in it.

This also made the right hand more clean. Before the distortion effect could still be heard quite a bit on the right hand, or upper register, and now it sounded more like only the reverb effect was influencing this input.

I think maybe this came in another experiment, right before my presentation? Then also change the goal!!)

After finding a significant improvement in sound and effect use, we focused ourselves on fine-tuning the Flanger effect.

Cláudio explained to me what the different parameters meant and he showed me how it can change the manipulation of the sound. We found that if we slowed down the speed of the Flanger that it bended the sound not too often but played with it just enough to create that whale-like noise. (so yeah maybe this n different day)

Conclusion of today:

2 microphones do make a significant difference. Not only is the quality of the sound better, it makes it easier to balance the sound of the harp, especially when it comes to which register to bring out more.

Besides this, it makes the problem of splitting the registers easier. When you focus the distortion effect more on the bases this comes out more pitch related while still sounding heavy in the effect itself. And it allows for the middle and high register to be more clean, by using no effect or a reverb effect. This knowledge opens up new possibilities for future creations as when, knowing that one effect can be related to one register, without interfering noticeably with the other registers.

## **Solo Session 1 montreal**

7 september 2024 and that week of

I arrived in montreal and I have my new set-up here. First challenge is checking the effects I already have and adjusting them to fit the new set-up.

## 18 September 2024 - first lesson with Caroline on the electronics

She brought the chimes and the pedal board for me to use. The pedal board in their scheme goes through the laptop and through the line 6. Since I won't be using a line 6 bypass, I will only connect it with the computer. For this I will need an adapter, which I will bring for next time. We didn't get to the set-up of the pedal board today, that's something for the next session.

She arrived with her husband Étienne, who knows more about ableton. He mostly wanted to check out the gear that I'm using today. The microphones they were very enthusiastic about, Caroline said they were the same ones as she has used to play the Concierto Techno. They also liked the audio-interface, very small and handy with enough in and outputs.

We started looking at some of the effects I have been working on. Over the past few weeks since my arrival to Montréal, I have been working on fine-tuning the effects to the material I'm using here. There were definitely still improvements to be made, but that's of course why I came to work with the composer herself. To hear from her what kind of sound she is looking for. During this first session with her, I showed her my progress on the different effects and she shared her feedback, which can be found below.

### *Reverb:*

I shared with her my thoughts that I like the reverb so far in the slower 2nd movement, but I think that in the faster movements 1 and 3 it makes it sound blurry. She agreed that the length of the notes as a result of the reverb is too long, making the sound unclear, blurry. The notes clash too much basically. Her observation about the length that the reverbs makes the notes being too long, brought me to an idea of an solution. The Decay of the reverb needed to be sooner, making the sound die sooner. When I turned that down to 1.53s instead of the previous 2.30 s, the difference was already audible. The resonance was just slightly less; the notes sounded shorter, meaning that there was less clashing of notes in the fast movement and thus a more clear sound, while still allowing the harp to sound electronically enhanced with an effect. (can show an before after?)

### *Flanger:*

Caroline's feedback to the flanger was that it sounded 'too square'. She said it wasn't sounding very natural, or sinusoidal, because sometimes the effect bends the notes very quickly. This results in a very icy sound, instead of the warmer whale-like noise that can be heard on Caroline's recordings.

Étienne pointed out to me that during the whole Stellar Sonata, effects come and go but the Reverb effect always stays on.

We tried to change the sound by changing different values, we even tried different Flangers, but couldn't really find anything that immediately worked. Normally, the Flanger effect that Caroline uses comes from their Line 6 device. Their Line 6 is a device from 2008 that is already installed with particular sounds and effects. It says in their 'recipe' for the Stellar that this Flanger is 'Jetflanger (modulation) based on A/DA <<studio quiet>> Flanger'. What I will try to do is find this effect online and try to get it as a plug-in in ableton.

### *Distortion*

Caroline liked the sound of the distortion itself. It's crispy and comes close to the way she has shaped her distortion sound for the Camac Big Blue. Her biggest concern was with the registers, since it's not completely split yet. Despite the work I've done with the 2 different microphones, she still feels that the top register doesn't come out enough. I can change this by increasing the input of the microphone for the middle and high register, making it sound louder. But this would mean that it would sound louder with a distortion effect on. Whereas what we actually want is for the sound to be clear, clean and with the reverb effect only.

So my job is to look into the use of filters again. If we cut the mid+high register for the distortion effect, and boost the basses, and cut the basses but boost the middle and high register for the reverb at this point in the Sonata, then that should help with achieving the kind of sound that Caroline is looking for. I think the use of equalizers might help us with this.

Etienne has sent me their presets of ableton live 11. It was in the standard so since i'm using the intro it could not open everything. It can be interesting to see if I can still do it in the intro, or at least how far I will get. Otherwise I can think about getting the standard version.

It's very useful for me to have this, so I can see what the end result more or less should look like in ableton. It can help me learn understand how the electronics work, and what I need to do to recreate them.

## Solo Sessions

*19 september 2024*

I found some information on equalizers. As stated by

<https://medium.com/@rossgeldart/how-to-use-abletons-eq-to-its-maximum-potential-49d80eb1380e#:~:text=At%20its%20core%2C%20Ableton's%20EQ,shaping%20your%20music's%20tonal%20character.>

‘ A powerful tool that allows you to adjust the balance of different frequencies in your audio tracks. Finely tuned knobs that can boost and cut specific parts of your sound spectrum.’

I think it might be interesting for splitting the registers to use equalizers, for the distortion effect.

I was thinking to try and find a way to divide it as the following:

Distortion: boost the basses but cut the middle and high register.

Reverb: Boost the high and middle register, but cut the basses.

*20 september 2024*

Today I made an overview of the effects, where they come from and when they need to be turned on. It was for me to understand also which effects actually come from the Line 6 and so I need to find plug-ins for these effects. I also wrote down questions for what I don't understand especially when it comes to programming the pedal board. In theory there's only 8 different effect used throughout the entire Sonata, but each effect uses multiple presets and plug-ins sometimes.

The cells are the following format: effect Name, Where does the effect come from, When is it used in the piece, Pedal board relation, Issues/notes/further questions.

### **Reverb Pedal 2**

Effect comes from Ableton with added equalizers, it does go through the line 6 as a 'bypass'

Effect is engaged during the whole Sonata

On the pedal board of Caroline programmed as pedal 2.

It states there's a bypass through the line 6 for the medium register, I'm not sure why. In the manual of the line 6 it seems that 'Bypass' is recognized as an effect which means it turns on the effect. I'm a bit lost on this part and will need to look further into the issues concerning the line 6.

2 different configurations for the high+ pick-up and the Bass. high+pick-up is utility, strings EQ 1 and Reverb. The Bass uses the same but adds an 'EQ Three'. It seems this has to do with how much it comes through in which register.

### **Flanger Pedal 7**

From Line 6

Appears in 2nd movement, measures 9-30 and again during 46 till the end of the movement

Programmed on the pedal board as pedal 7. Before the start of the 2nd movement, the player needs to make sure that button 7 is on, while the volume pedal is closed. The effect itself is turned on and off by using volume pedal during the piece → why? Is it because it needs to be gradual?

This effect also exists in ableton but so far the sound is not completely the same. In the line 6 it's called a Jet Flanger and based on a specific version of a flanger effect.

### **Distortion Pedal 8**

From Ableton live

Appears in the 2nd movement, measures 30-43

Programmed on the Pedalboard as the 'Bank' or disto pedal.

The Distortion effect consists of Utility, Distort, saturator and string EQ 1. I currently only have Saturator, so I might need to look into adding the rest of the building stones.

### **Reverb 'space echo' Pedal 6**

From Line 6 Bass POD

Appears in 3rd movement, measures 1-31 and technically also 48 until the end since pedal preset 5 is the same configuration on the line 6 as this effect.

Programmed onto the number 6 of the pedal board. → why does it appear again but now as Pedal 5? Why could pedal 6 not be used again for the same effect?

The effect of the Line 6 is called 'multi-head' (delay/reverb) based on a specific version of a space echo.

### **Analog Delay Pedal 3**

From Line 6

Appears in the 3rd movement, between bar 31 and 34

Programmed on the pedal board and pedal 3, it uses the volume pedal to be turned off, so it's important that the player has opened the volume pedal at the beginning of this movement.

It's very important the timing of turning on and off this effect, since a slight difference can mean too much or too little sound information being repeated in the delay. The effect itself will keep sounding after the volume pedal is turned off, allowing the playing to play the next couple of measures along with the effect, using it as though it were a metronome. The speed of the delay needs to be 76 bpm more or less. In bar 46 the speed of the delay effect is tweaked and then slow down before getting rid of it completely and starting the next session → is this correct? Or is this the ping pong delay that gets tweaked.

### **Ping Pong Delay Pedal 4**

From Ableton

Appears in the 3rd movement, measure 46 and 47 only

Programmed to pedal 4 of the Pedal board. I'm unsure which delay gets tweaked in measure 46.

Effect consists of utility, strings EQ 1, Reverb, EQ Three, and Ping Pong Delay. I could not find yet an effect called ping pong delay in Ableton, only one 'ping' and another 'pong' and a number of other standard delay effects.



The reverb space echo from pedal 5 is the same as the one of pedal 6, and the questions about it's programming onto the pedal board have already been posed in the table on Pedal 6.

The same goes for the CTL pedal. It's the same effect as pedal 4, the Ping Pong Delay, but this time returning on the CTL pedal. When getting to try out the set-up of Caroline Lizotte, I noticed that this is the only pedal that one needs to hold down in order for it to keep sounding. So my question for this specific effect and pedal is why it needs to be held down. And again why is it not the same pedal preset as pedal 4? Why not reuse that one?

I noticed that the ableton effects consists of multiple elements, one of them being equalizers, the other the effect itself, and then finally something called Utility. The Utility is according to Ableton itself 'a small swiss army knife for audio. It can be used to change gain, separate a single channel from a stereo signal, widen or narrow the stereo image or suppress DC offsets. It uses almost no CPU (central processing unit).'

'So, if there is a DC offset, the speaker's center of motion is shifted so that it does not correspond to the speaker's rest state.' (forum.ableton.com)

Why the utility tool is in every ableton effect I don't fully understand yet. The equalizers I think have to do with which register of the harp comes out more for which effect.

*23 september 2024*

I worked on improving the sound of the distortion, possibly with equalizers.

In this session I mostly tested what some different equalizers do, to have a better understanding of how they work and what I can achieve by using them. The hypothesis before working was that the use of equalizers might allow for the canceling out of a register in a certain effect, which is what I need for the effect of the distortion.

I just proceeded to try out a few different ones. Here's what I found:

EQ Less Low More Mid:

This equalizer allows for control over the gain of the low, mid and high, referring to the different frequencies. The goal of this equalizer is to cut the low, so it's the opposite of what I need. It can be heard in the fact that it doesn't really amplify the lower notes of the harp when they are played. It might still come in handy when it comes to boosting the reverb effect on the middle and high register if necessary so it's something to keep in mind.

EQ Remove

This equalizer can remove certain registers, by the same concept of gain buttons for each register, low, mid and high. It seems to cut a little bit of the register being influenced, but it still lets through part of the sound. Furthermore, it affects the sound of the effect and the harp a lot. In the sense that the sound became for example more nasal, the more a register is cut, while I would like to maintain a more warm and round sound. There's also a lot of background noise when the effect is initially turned on. I'm not sure why that is.

Include maybe more info on the equalizers. Include what you will find out this week and in the session with Felix.

*25 september 2024*

Today I worked on testing different delays and understanding the possibilities of this effect. A deeper understanding of delays will allow me to work more productively in recreating a specific sound and speed, I will know better what to look for and how I can influence this.

In the technical recipe from Caroline, the delay effect that comes from Ableton is called 'Ping Pong Delay'. I could only find a 'Ping' or a 'Pong' delay, not ping pong. Or other delays such as quarter note, half note, sixteen note, etc delays as well as some vintage

delays, which influence the sound even more in its looping than just creating a delay of the played note.

It seems that on all these delays in general the speeds of the delay can partially be changed by using the sync option. On '2' it seems to almost be the right tempo, but changing it to '1' makes it too fast, and something like '4' too slow. It seems to speeds or slow down in doubles or half. I need to find a way to change the tempo in bpm's in order to suit my exact needs.

There's a graph in the effect with an x and y axis, and a curve going through it. The curve can be change by taking the little circle and moving it around the graph. When experimenting a bit with this, I found that changing the circle along the x axis changed the register (the software calls it filter) it picks up, or reflects, and moving it along the Y axis changes the type of sound of the delay, mostly how warm or dry the sound is.

## 26 september 2024 - Lesson 2 with Caroline Lizotte

In my lesson with Caroline I asked her the questions I had about the effect's programming and pedalboard assignment.

I got to ask the questions that I had about the effects, particularly related to the pedal board, but also the sound of the effect in general.

'Bypass' just refers to an effect on the Line 6, which turns on or triggers the effect. It does not influence the sound son technically there it no effect, but just allows the sound the pass through. This is used for the Reverb that is on during the whole of the sonata. This effect comes from ableton but it is to make sure that the reverb is on even when the Line 6 is being used. (I think)

### *Space Echo*

This effect has even more reverb than the standard reverb. It is a reverb combined with a bit of delay. It's also more metallic in its sound. Caroline said it's almost like it has a very short delay. You hear very shortly these staccato notes after having played a note.

For the pedal placement, my question was why does this effect come back on a different pedal, if it's the same? Caroline said she programmed the pedalboard so that the 'active pedals', the pedals that need to be pressed while playing a movement, are at the bottom row. The pedals that can be pressed in between movements are at the top. This allows for easier access while playing the piece. The 6 is at the top and so at the beginning of the movement she presses this, but while playing she triggers it again using the 5, which is located at the bottom.

For thinking about pedal board requirements, there could be a way to have them both in just 1 pedal, when positioned correctly.

### *Ping Pong Delay 4 and CTL*

They are in fact the same effect. They could have been on the same button, but isn't for 2 reasons. For the end of the piece, which is when the CTL is used, she wanted it to be the button right next to the D pedal (the far left), since the effect needs to come right after having used this pedal, which is the CTL button. However on her pedal board, this button is a bit broken, and only works when you keep it pressed down, not anymore once released. Since earlier in the piece, you need to trigger the Ping Pong Delay while using your left foot for other pedals and such, she needed another button to have the

effect keep sounding. So this became the 4, which is on the bottom row of the pedal board. She kept the effect on the CTL as well, because of the closeness to the D pedal.

The effect of the Ping Pong delay itself, blurs everything. The playing and the sound of the analog delay that was still sound at that point in the middle of the third movement. The analog delay slowly decays over time, while the filter increases. The ping pong delay blurs everything, and then you can with the line 6 influence the speed by tweaking the affect button by hand, increasing it and then turning it off and taking the sound.

### *Volume pedal*

The volume pedal is there just to have a handy on and off button, I suppose the bottom row was getting quite full.

Caroline also said she had it to make the effect come in gradually, but etienne said that this was not a thing, it's on or off. So any gradual control she seems to feel she has over the effect, seems to be in her head then? I don't know haha anyway she said just on and off is also fine, whichever way.

Etienne helped me set up the pedal board, notes in the notebook.

## **11 october 2024**

I've been trying to copy caroline's effects from ableton into my own file as much as i could. But I ran into some problems with this, since she's using th Suite version and I'm using the Intro. Some effects do not allow to be copy pasted, So i had to look for other ways to replicate them. I decided to take screenshots of the things that didn't work to manually recreated them. With the utility tool, I saw that there was a difference because it says 'mid/side' on hers and 'width' on mine. I don't know what this means for the sound. I also want to try out how this tool impacts the sound, and I would like to ask Caro while she chose to have these kind of tools in the effect. The same would go for the equalizers, I want to hear the difference with and without.

## **18 October 2024**

Session with Felix Rivest.

Felix worked with me a bit on the effects that I have so far. He explained to me some details of what an Equalizer is, how it can cut out or boost certain registers. It's basically a tool to clean up the sound. Since I'm using the intro version of Ableton, I only have equalizers that allow me to change the settings of the registers with buttons, instead of seeing it in fullview with a graph as it is available in the EQ3 from the Suite version of Ableton. For this, Felix gave me the tip of installing a free plugin TDR Nova: <https://www.tokyodawn.net/tdr-nova/>. This plugin in is essentially the same in functionality as the EQ3 from the suite version. With this equalizer, we managed to split the reverb into 2 different tracks: one for the high and mid registers, cutting the basses, the other for the Bass register, cutting the mid/high. We also cut the mid/high register in the distortion effect. Now, if you turn on the mid/high reverb track and the distortion effect, it puts distortion on the basses and lets the middle and high register of the harp come through clearly with a reverb effect on. This is how Caroline intended this effect to sound. It's pretty precise in its splitting, the most precise solution that I have found so far. I only have to think about this how I will program this into the pedal board. But for now the desired sound seems to have been achieved.

## **28 december 2024**

Session with max frimout

Valhalla Delay, has analog, tape delay and a space echo for 50 euros.

Place in Return track, because needs to take a specific part, then turned off and ten send again for the end of the delay. Multiple layers.

Program on midi with a button that can open and close. Open for the part of the gliss and the beginning of the loop, then turn off. The delay keeps going but doesn't take new information. Then towards the end of the loop in bar 43, it's turned back on so it adds new information to the delay/loop. The tweak effect can be created by manipulating the delay time with the buttons of the plug-in. Also these can be assigned to a midi.

## **2 February 2025**

Worked on the delay and the space echo

Delay is sounding much better. Just experimented with the buttons a bit till I find the right sounds. Initially the loop sound it created was too low and too much wow effect. So I changed the buttons till it sounds more like the recording. A lot of going back and forth between listening to my delay and listening to caro's recording. Also made a video of me playing over it. Still at the end I feel it gets a bit soft and it does still become a bit low in frequency sound wise

Space echo is tricky. It's so particular. I do have something cool now but it isn't as basey as caro's. I'm not sure if the staccato character is the same. I remember when you played one not on caro's setup that it gave these 4 sixteen notes kind of. This is not the same for me right now so I need to just tweak the buttons till I find it.

Ping Pong delay

Generally sound is fine and the fade also just it's slightly too fast but I didn't find yet how to change the speed

The distortion has a buzz when I turn it on and I don't know why

Still not completely happy with the Flanger effect, The phasing is nice but not the sound it turns it into. It's too icy and not enough like a whalesound

### **3 February 2025**

Analg delay:

I don't yet understand what the ping ping delay does at the end of this section, in bar 46. Caroline said it was to 'blur' but since nothing is being played at that moment I don't fully get what gets blurred. I could sort of hear it when I was playing on her gear, but when I do it in mine I don't hear much difference. But that might just be bc I have to do something differently in where the signal is sent, maybe it should also send to the valhalla delay in B.

Besides this, it seems that the idea of quarter notes in the settings of the delay doesn't work because then we cannot tweet the delay time at the end of the loop. So I went back to experimenting with getting the right delay time that results initially to a beast of 76 bpm.

Also for the ping ping delay important to know it's a delay of 66 bpm.

With the project tempo at 76, the analog delay has a delay time of 772.5 ms to match the 76 bpm of caroline's delay. However, this might change if I need to change the project tempo for the ping pong delay.

### **4 February 2025**

I noticed in the configuration page on the stellar sonata that the project tempo of Caroline's file is at 132 bpm. So I changed mine to that as well. Now for the Ping Pong delay the left/right sync is on the number 4. Not sure what this actually means fully but it does result in it being the right tempo of 66 bpm!

Changed the delay time of the analog delay to 780 ms. seems to be okay for now but need to work a bit on the sound again.



## **8 february 2025**

A buzz appeared in the background of the application, so some trouble shooting was required to fix this problem. Even when all the tracks are closed, but output is turned on, the buzz still appears. It increases with the amount that the output is opened.

There seems to always come in a signal from the mics, since on the interface, the signal light is always green, so they're always picking up sound.

Solution: it came from the power of the speakers that the mics picked up on within the cycle. Changing the power supply fixed it!

### *Changes today:*

Ping Pong: different activation of effect.

I realised that I need to activate the Ping Pong delay differently, especially for it to influence the sound in the loop. It needs to be 'listening' even when the track is not producing any sound, so that it adds sound to the mix that has already been played before it was turned on. For this, the settings of the activation of the effect need to be the following: have the Monitor on On instead of Auto, and use the number of the track, which will now appear in blue instead of orange like the other tracks, to activate and deactivate this effect, instead of using the record button.

With the delay/loop it doesn't really do much just yet, but that might also be down to other things that just this effect.

### Analog Delay:

The right delay time for it to reach 76 bpm with the file speed on 120 is 780 ms.

I assigned the delay time to a button that's a type of volume button on a MIDI controller.

I used NanoKontrol 2 from Korg like I had used before for my PIA. Now I can change/control the delay time, which I need for the ending of the loop.

Experimenting with this gave interesting sounds but not yet the results that are intended for this part of the music. Further experimentation is required for this part.

The sound doesn't stop right now at the end of the loop, so the effect itself also needs to be MIDI-assigned.

## **11 February 2025**

Today I received the pedalboard Nektar so I decided to set that up with the effects. Need to watch some tutorials.

Went on to refine the end of the delay/loop with tweaking the delay time button. I tried to recreate to motion that Caroline does for this. A sudden abrupt change in lowering the delay time and then slowly going to higher, before taking it out completely. But even while doing that more precisely as is intended, it simply did not sound the same because it's not an actual analog delay from this specific device Line 6 basspod. I might refine the space echo and then send a video to Caroline to hear what her thoughts are. It does sound cool either way, but it's not the same. Could be an interpretation of a sort.

### Space Echo

For this effect you need to hear sort of 16 notes shortly after a note is played. Caroline showed me what to listen for on her gear, these staccato notes that come from a delay. Not for too long. It was quite a dry sound, while still having the spacey reverb.

For recreating this effect I used the valhalla plugin on a tape delay. But now I put the delay time on note 1/16 which gave short staccato notes. I checked the amount of feedback to make sure it didn't keep going for too long. I added some wow and flutter to add a bit more to the sound effect itself. Now it sound pretty close in my opinion.

## **12 February 2025**

Setting up de pedalboard: did not figure it out yet.

I changed the amount of Feedback on the delay to a little bit more

## **17 February 2025**

Session with Tomasso Rolff

### *Flanger:*

It sounds quite icy, is it posible to have more warmth?

After showing the original Tommy understood what I meant with this. We tried to change some things in the settings of the effect but in the end he started looking for a plug-in for this effect that the original is based on. He found a plugin and send me the link for it. It's 10 dollars so not too bad.

### *Analog Delay:*

3 problems:

1. It needs more building feedback, but just putting more feedback percentage makes the sound very ringy and unpleasant very soon.
2. When the Ping Pong delay is activated, not much changes to the sound, doesn't seem to blur like Caroline intended.
3. The sound of the Delay Time, doesn't sound the same, is that because it's not analog or is there something we can do about this?

A couple of things arose that solved these issues. For the first, if we also increase the drive, it will gradually get to that ringing pitch but not too soon, this along with a little bit more feedback had the desired results.

Then the Ping Pong can be activated slightly sooner, which in combination with these other changes does blur the sound and creates some feedback. It can't be too soon however, so that it doesn't add what was played to the mix. But it does need to be a bit sooner than is written in the score because it needs more time to get to the high pitch due to the algorithm.

The tweaking of the delay time needs to be more and more gradual also, to find the 'sweet spot' of where the delay starts to create this high pitched noise. Then turn really slowly to create the whooshing noise. It's much more sensitive than Caroline's because the range is higher, 0 to 2000 ms instead of 20 to 40 ms. It will probably help to use a MIDI controller that has slightly more resistance to avoid turning the knob too fast and aggressively. This one is very smooth and so you can turn it too much very easily. If you turn too much, too close to 0 ms, then the sound just disappears, and if you don't turn enough, it takes a very long time for the feedback to come, or it doesn't arrive at all.

Tommy said to still experiment with the different settings of Past, Present, and Future for the Delay, since this changes the algorithm, which can then influence the sound and interaction of the feedback.

### **18 February**

Further practice and experimentation. Recording some effects.

**24 February**

Call caroline with feedback (notebook)

**25 and 26 February**

Last experimentations and changes to the effects. Recording final versions for the research.