CMP4 Mark Allidine Professional Project Thesis

Mix engineering – a comparison of free and paid audio plugins and hardware

Date: 27/04/2022

Supervisor: Peter Meighan

Abstract

This thesis is a comparison of free and paid audio plugins and hardware. This project aims to discover whether or not freeware plugins can stand up to their paid counterparts in the context of a mix and if there is a significant time investment making it not worthwhile. Four tracks were written by a client and composed, arranged, recorded, and finally mixed twice per track. One mix includes paid plugins and hardware while the other mix uses only freeware plugins. The tracks were mixed in *Ableton*, and an important distinction is that the tracks were not mixed using any stock plugins. This assumes ownership of a digital audio workstation (DAW) which may not be financially feasible for new producers.

The project is aimed at the average listener who will be hearing tracks on entry level earphones or built-in phone or laptop speakers. In this context, the freeware plugins performed to the same level as the paid plugins. The client was given a blind test of both mixes of each track and asked to pick their preferred mix. In the case of two tracks, the client chose the free mix and in the case of two other tracks, the client chose the paid equipment mix.

While the free plugins performed to a very high level the main discovery was a lack of certain types of free plugins that a beginner producer may try to budget for. These were a pitch correction plugin and an audio restoration plugin if desired such as *Izotope RX-8*. Of the pitch correction plugins tested, the most effective method was cutting the audio file and editing the cents and semitones manually in Ableton in conjunction with the free plugin *Graillon II*. However, every free pitch correction plugin tested lacked the functionality of popular pitch correction software such as *Melodyne* or *Waves Tune*, which allow the user to manually place the notes of a vocal or monophonic instrument on a piano roll and make more surgical edits that do not sound robotic or metallic.

Overall, the study revealed that any mix engineer with a high level of experience can create a professional sounding mix provided that the tracks recorded are of a professional standard. It was discovered that by focusing each stage of production at the final mix, that mistakes were limited, and the mixing stage workload was lessened.

Table of Contents

Introduction

The topic under research is “mix engineering – a comparison of free and paid audio plugins and hardware”. This is worthy of study as many producers particularly in a home setting have developed a habit of purchasing many audio plugins without understanding them thoroughly or often not using many of them as they come in bundles. This research aims to examine if there are any huge differences between free and paid audio plugins and whether or not the same results can be achieved with one approach or the other. The end goal of this research is to discover which paid plugins, if any, are deemed ‘essential’ in order to achieve the most professional results possible. The aim is to strike a balance between the most important plugins that can be budgeted for by producers while also making use of the best available free plugins.

The project entails writing, arranging, recording, and mixing four track EP for a client. The tracks will be completed in both a home studio and professional studio environment before two separate mixes are done for each track. One mix will be completed ‘in the box’ using Ableton Live 10 Suite however no stock plugins will be used. This is to ensure that the project is viable for anyone to complete for free using a free digital audio workstation (DAW). The second mix will use a combination of hardware equipment from a professional studio and paid audio plugins using a DAW. This mix will be making use of industry standard software and hardware to see if the mix is worth the money spent versus time saved and whether or not it sounds more appealing than the free plugin mix. A blind test will be conducted at the end with the client to see which mix he prefers for each of the four tracks. Mixing targets in terms of Loudness Units Full Scale (LUFS) will be set to achieve the same balance for both mixes. This is discussed in the literature review section of the thesis.

The literature review will analyse academic work existing in the field of mixing and the effects of audio processing on the perceived overall sound. The work discussed relates directly to the research question and the approaches and workflow of the various professionals will be studied and adapted to suit the project at hand. For example, the investigation into dynamic range compression is essential. An expert listener can tell the difference between hardware vintage compressors and software emulations while listening on studio monitors however the average listener has not developed critical listening skills

and is usually listening on earphones or often entry level headphones. This is the key target demographic for producers and mix engineers, so it is important to understand their viewpoint. These theses and academic works will provide a foundation for the research and will allow for a fair comparison between free audio plugins and a mixture of paid audio plugins and hardware.

The methodology section will examine the overall approach to this research project. The creative process is outlined in detail, step-by-step. The rationale for each decision is discussed in depth with a logical explanation for why a certain approach is taken at certain points. Careful planning at every stage is critical. In order for the mix to be successful, ample time must be allowed for the mixing stage and the recordings must be of the best possible quality in order for the research to be successful. It is important to remember that mixing is one of the final stages of post-production where the engineer aims to optimise the pre-existing material. The client relationship is of utmost importance for the best possible performance to be achieved. Getting the best results from the multiple variables such as the client's writing, performance and recording are essential for the mixing phase to be successful. Extensive research into the best free plugins available will also give this comparison the best possible chance at success. The aim is to find the best approach or cost-effective blend of approaches. For this to be achieved, the free plugins must be understood thoroughly and used to their full potential.

Literature Review

The topic of study is comparing free and paid audio plugins and hardware. The literature review will analyse eight pieces of literature which are relevant to this topic of study. The academic studies cover the full scope of the project and informed decision making at the pre-production, writing, recording, and mixing phases of the research project. There are many studies investigating more varied genres of music however as this research topic is limited to folk style, popular music, this is the rationale for selecting certain pieces of academic work over others. The research is presented in a context that keeps the average

consumer as the primary focus. Expert listeners using high-end listening systems will be more easily able to tell the difference between free and paid audio plugins and hardware. However, the average listener of popular music in particular, will be using low budget earphones or built-in speakers, often on a phone or laptop. This is important to remember when mixing for this genre.

The paper "Evaluation and Modelling of Perceived Audio Quality in Popular Music, towards Intelligent Music Production" (*Wilson,* 2017[1]) conducts a subjective and objective evaluation of musical quality perception of commercially released music. The available budget, human resources and projected time-to-market were all constraints that were used to evaluate the quality of material.

A panel of twenty-two participants were tested (eighteen male, four female) over a period of five consecutive days. Each participant chose their level of expertise based on participation in previous listening tests. Thirteen were experts and nine were non-experts. Each participant chose two preferred genres for the test. The opinions of the non-expert listeners are key for the current research topic as the final mixes are aimed at these listeners in particular.

There were key takeaways that were applicable to current topic of research. The study found that positive ratings of quality were correlated to signal amplitude, loudness, and dynamic-range-compression while negative ratings were generally correlated to words to describe sonic attributes such as 'distorted' and 'harsh'. The study discovered that "quality in music production is revealed as a perceptual construct distinct from hedonic, musical preference, which is more likely influenced by familiarity with the song"[2]

This meant that the songwriting and arrangement process were hugely important in this project in order to create high quality mixes. In the genre of folk style music that was created, the listener does not expect to hear distortion or harshness described by the

[1] Wilson, Alex. "Evaluation and Modelling of Perceived Audio Quality in Popular Music, towards Intelligent Music Production." *University of Salford*, Alex Wilson, 2017, pp. 1–292. https://usir.salford.ac.uk/id/eprint/43345/1/AlexWilson%20-%20PhD%20Thesis%20-%20FINAL.pdf

[2] pp. 32

panelists, so this was important to remember in the mixing phase and is applicable to the current project. The mentioning of positive ratings correlating to loudness and dynamic range compression informed decision making in the mixing phase. This meant that the tracks had to be as loud as others in the genre and that people will expect to hear the vocal up front in the mix and compressed. This is typical of songs referenced throughout the course of the study.

The thesis "Audio Digital Signal Processing, Techniques and applications" (*Belardinelli,* 2009[3]) investigates the effects of Digital Signal Processing (DSP) on audio signals.

The study looks at different forms of DSP such as audio digital watermarking, audio restoration and audio virtual reality. Digital audio watermarking was investigated in the context of the quality of an audio signal after the process of MP3 coding, transmission, and respective decoding. It is used to protect the misuse of copyrighted material created by artists. The experiments allowed a *fragile* digital mark to be embedded into the middle-high audio signals by separating an audio stream into 2-second-long time slots.

The study analyses digital audio restoration methods which allow achieving a better degree of freedom compared to the analog methods previous. This is important for the current project as there are many modern plugins which use these methods in different contexts such as *Izotope RX-8.* This plugin was used for the mixes which use paid plugins for removing mouth sounds, removing unwanted noise from audio signals, and removing audio clicks. On one track in particular in the project, there was audible crackling sounds on some of the recorded signal. *Izotope RX-8* was used to remove the crackle and restore the track to the expected sound. As the writer notes this is "a very active research field where definitive and optimal results are still to be achieved."[4] There were no freeware alternatives to Izotope RX-8 so if audio restoration was of critical importance for a new producer in the context of sampling, perhaps, this could be a plugin to budget for when starting out.

[3] Berardinelli, Carlo. "Audio Digital Signal Processing: Techniques and Applications." UNIVERSITY OF ROMA3, ROME; ITALY, Carlo Berardinelli, 2009, pp. 1–87 https://arcadia.sba.uniroma3.it/handle/2307/501

[4] pp. 32

The Research article "The Impact of Audio Effects Processing on the Perception of Brightness and Warmth" (*Bromham, et al,* 2019[5]) examines the effect of low bit rate and low-grade conversion quality on the overall brightness or warmth of a sound. There are many plugins that emulate early sampling technologies that were used throughout the course of this project. Brightness and warmth are challenging to define and measure so this study attempted to do that.

A series of audio tracks which had been processed with different audio effects were tested on twenty-six participants who rated the perceived brightness and warmth of different instrumentals. There were five different types of audio effects tested including bit depth reduction, compression, and equalisation. All of these audio effects are applied in the mixes of the current topic of research so the results are of utmost importance for this project.

The key learning points were that "8-bit reduction tends to increase brightness and decrease warmth whereas 12-bit reduction tends to do the opposite, although this is very much dependent on the instrument. Interestingly, the most significant brightness changes, due to bit reduction, were obtained for bass sounds."[6] When instruments are compared with an analogue compressor and equalisation plugin and more warmth was noticed when the sounds were processed using plugins which simulate the hardware version.

This research is important to note as a key part of this project is to create a high-quality mix both with paid and free plugins that the average listener can appreciate and enjoy without criticising sonic elements or mixing errors. It is interesting to note that the participants noticed more warmth in the simulations of the hardware equipment and this is discussed later in the context of this research topic.

A PhD thesis study was conducted titled "Towards a better understanding of mix engineering" *(De Man, 2017)* [7]. This study provides an analysis and evaluation of real-world

[5] Bromham, Gary, et al. "The Impact of Audio Effects Processing on the Perception of Brightness and Warmth" The Impact of Audio Effects Processing on the Perception of Brightness and Warmth, 2019, http://davemoffat.com/wp/wpcontent/uploads/2019/09/BrightWarm-AM19.pdf.

[6] Bromham, Gary, et al. "The Impact of Audio Effects Processing on the Perception of Brightness and Warmth" The Impact of Audio Effects Processing on the Perception of Brightness and Warmth, 2019, http://davemoffat.com/wp/wpcontent/uploads/2019/09/BrightWarm-AM19.pdf. pp1

[7] De Man, B., 2017. *Towards a better understanding of mix engineering*. Ph.D. Queen Mary University of London

mixes to prove that this form of learning is an important part of improving one's own mixes and how they are perceived. The research aims to further current knowledge of multitrack mixing and discuss the challenges faced at present. The current project while being mixed to a professional standard may have a better approach that exists if undertaken by a mix engineer with many more years' experience. By studying the authors work, some of these errors were eliminated in order to avoid some of the common challenges faced such as masking or over compression for example.

A database of six-hundred audio recordings was provided and were "subjectively evaluated by 33 expert listeners, using a new framework tailored to the requirements of comparison of musical signal processing." Some mixes were produced and mixed by professionals.

The study looked at the relationship between the framework and objective audio features. This allowed results to be verified or revised and new rules to be created using a set of terms. It was noted that examples of bad practice in processing combined with the listener's subjective review provide invaluable insight into the impact of the mixing process on perception.

This thesis took a similar approach to the current project. Sixty-four different mixes were produced by sixteen mix engineers from one song and the plugins used were constrained before rigorous subjective evaluation with the panel of expert listeners. The thesis provides an extremely useful summary of mixing rules after the study was conducted. This set of rules includes loudness unit averages and approximations for typical elements found in a mix. There are also rules for artificial reverberation, panning, equalisation and dynamic range compression.

This was used in the current project as having a set of controlled variables between the free plugin mix and the paid plugin mix was important in order to achieve the best mixes possible for comparison purposes. Both mixes were to be roughly mastered to the same

https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/25814/DE%20MAN_Brecht_PhD_Final_090517.pdf?sequence=1&isAllowed=y.

loudness levels as a chosen reference track in order to make a fair comparison at the end of the project.

A study titled “An Investigation into Non-linear Sonic Signatures with A Focus on Dynamic Range Compression and the 1176 FET Compressor” (*Moore, 2017)*[8] was undertaken. This thesis looks at dynamic range compression, one of the most common processes in mixing. Audio signals have their dynamic range controlled in order to reduce the risk of overloading recording devices or it is used commonly as a tool for colouration.

This research looks at “sonic signatures, distortion, non-linearity and how audio material is coloured during the music production process.”[9] The study analysed the different compressors commonly used by music producers and what instruments they typically use them on. The research revealed that they use compressors to manipulate the timbre of audio signals and choose particular compressors with specific settings to add colouration.

The study tested several vintage compressors such as the Teletronix LA-2A, Fairchild 670, Urei 1176 and dbx165A. The study also catalogues the 1176 compressor with a range of settings to compare it to reissues of the same compressor and the popular Universal Audio plugin version of the 1176. This is important for the current project as a number of different plugin versions of these popular vintage compressors were tested throughout the course of the study including both a freeware and paid emulation of the 1776 and LA-2A and a hardware Distressor compressor.

Overall, the study found that the compressors all have subtle nuances unique to them. They all colour the sound differently and this research will be used during the mixing process in order to test different vintage compressor plugin models on program material specified by this research. It is important to remember that this research is targeted mainly at the average listener and it is doubtful whether or not they can hear these subtleties on entry level earphones or built in speakers.

---

[8] Moore, A., 2017. *AN INVESTIGATION INTO NON-LINEAR SONIC SIGNATURES WITH A FOCUS ON DYNAMIC RANGE COMPRESSION AND THE 1176 FET COMPRESSOR*. PhD. The University of Huddersfield. http://eprints.hud.ac.uk/id/eprint/34118/

[9] pp 3

The next study “Multitrack Mixing an Investigation into Music Mixing Practices” (*Tot, 2018*) [10] investigates the mixing practices and workflows that are used consistently by professional mix engineers. The study looks at a history of mix engineering before providing analysis.

Ten participant mixes were studied with a panel of twenty-one people giving feedback in order to compare the dynamic and spectral audio features of each multitrack and the final mix. Research was completed and extracted eight-hundred equalisation and three-hundred compression rules based on what professionals do in their workflow.

Text mining was done in order to gather data about the methodology of twenty-one mix engineers. The data showed that the engineers agreed on negative and positive ratings towards different mixes. The study combined their ratings on elements such as dynamic and spectral audio data allowing the author to max an overall quality assessment. Finally, this collection of data allowed the researcher to better approximate the settings and parameters used by mix engineers.

This study and collection of data provides parameters and settings that enhance mixes. This was consulted throughout the course of the project as these settings come from professionals who have more experience and a better understanding of critical listening. Using simple tricks such as the common colour coding process for multitracks or using subtractive equalisation more than additive made the final result more professional. The study makes clear that EQ and compression are the most common effects processing put on tracks and using this information for example makes the tracks sound closer to what the average listener would expect to hear.

The next source “(The 247 Best Free VST Plugins Ever [2021 Update], 2021)” lists a large number of popular free plugins.

[10] Tot, J., 2018. *Multitrack Mixing an Investigation into Music Mixing Practices*. Undergraduate. Staffordshire University. https://www.researchgate.net/publication/324808456_Multitrack_Mixing_An_Investigation_into_Music_Mixing_Practices

The author has divided the list into a number of categories such as synths, drums, compressors, and reverb. There are a huge number of free plugins available for download and the quality ranges enormously. This project aims to source the best available free plugins and this list provides a solid foundation for research. A number of these plugins will be selected and tested during the free plugin mixing process after recording.

While this resource is extremely helpful there are plugins that will be disregarded. For example, virtual instruments emulating the sound of a bass guitar or acoustic guitar will not be used in place of the real instrument. While some of these plugins are effective, the technology has not reached a high enough quality to replace the real instrument.

A number of the plugin emulations of vintage compressors mentioned earlier in the literature review are listed on this site. These will be tested in the free plugin mixes and compared against the paid versions of the same emulations in order to see if any of the free plugins can outperform their paid counterparts.

The final source "Mixing as a performance: Creative Approaches to The Popular Music Mix Process" (*Anthony, 2017)*[11] looks at mixing as a creative process that the mixer is emotionally involved in. The author looks at mixing as "the icing on the cake. The icing being the final creative layer".

This study looks at the practical applications of mixing as a performance element in the digital era of music technology. The author cites a 1979 work by Edward R.Kealy in which the studio is likened to a musical instrument. It is noted that both the performer and listener in the studio have an emotional connection while recording. This is important for the topic of research as while the technical aspects of sound engineering are critically important, one cannot forget the human aspects of working with clientele and trying to get the best performance possible from musicians. This was kept in mind in each studio and pre-production session.

[11] Anthony, B., Mixing As A Performance: Creative Approaches To The Popular Music Mix Process. *Arp*, https://www.arpjournal.com/asarpwp/mixing-as-a-performance-creative-approaches-to-the-popular-music-mix-process/ [Accessed 28 October 2021].

The journal notes that critical listening is a key part of the creative mixing process. It is suggested that sonic manipulation of a mix is "a reaction to the artist's influences, and these social, cultural, or musical stimuli may all stir emotions." The author conducts an interesting experiment by recording two of his mixing sessions. It is clear that tactile involvement in the studio and mixing process can have a huge impact on creativity in the mixing process. It is easier to become emotionally attached to the task at hand.

Overall, this journal provides interesting approaches to improve one's creativity in the mixing process. Techniques such as involving elements of tactile control in the mixing process will be tested. The author notes that the mixer should be familiar with the technology, mix reference tracks and have faith in their ability. These are important points for the project and will be reinforced throughout the course of the study.

Overall, these bodies of work advised the project throughout and provided a point of reference for key tasks particularly in the mixing phase of the project. It is evident that good material has to be recorded before the mixing stage in order to get the best possible results. By treating each phase as part of the process of mixing, the producer can lessen the workload down the line and leave less issues once the recording and mixing stages are reached. This place a huge importance on pre-production. There are key learning points from these bodies of academic work that will provide a foundation for plugins to use, appropriate levels for the elements in each mix and targets to strive for regarding the average listener.

Methodology

This project aims to compare free audio plugins with paid audio plugins and hardware equipment and see if there are any fundamental differences or necessity to buy certain plugins. The recording phase of the project provided the foundation for this testing and is discussed in this section as it is of great importance. As the methodology will examine, a large portion of the timeline of the project was dedicated to the mixing phase as this is the key area of research and took a large amount of time. Eight individual mixes were completed throughout the course of the project. The research studied in the literature

review section has advised a number of decisions in terms of plugins to consider using, appropriate levels for the elements in the mix and psychoacoustic properties that can be exploited to manipulate the experience of the listener.

The first task for this project was to make contact with the client and discuss their ideas and aims for the work. While this research aims to find the best out of a plethora of plugins both free and paid, the genre and sonic characteristics of each arrangement are important to determine which plugins will be used for the work. A playlist of reference tracks was created for the project which informed some genre specific plugin decisions and arrangement choices.

One track of particular interest was Maggie Rogers record 'Past Life'[12]. This song makes use of old analog equipment including reel to reel tape machines, delay, and reverb units as well as some hardware compressors that are modelled off those discussed in the literature review. While most of this gear was not replicable for the research project due to cost and availability, plugin emulations both free and paid were tested for processes such as tape emulation and hardware compression. This provided an extra layer of detail in not just the comparison of free and paid plugins but also seeing how closely these emulations are to the original hardware units when perceived by the average listener.

The next step in the process was deciding on a production plan for the project. This included a detailed timeline of events such as writing and arrangement, recording a demo of each track, studio recording days and mixing. It was important to allot a significant amount of time for the mixing process as each track will have to be mixed twice. Each initial mix had a planned one-to-two-day rest in between with a maximum of four hours work on each track per day. This ensures high quality decision making while mixing and allows for fresh ears while approaching this process. There was an emphasis placed on getting high quality guide tracks particularly for vocals as the studio time had to be allotted to a tight schedule with the most important items such as main vocals and piano prioritised for these days.

Another key aspect of this project is the creativity in both the writing, recording and mixing phases. The production plan allowed for creative time in each week in order to try new

[12] Maggie Rogers. "Past Life". *Heard It In A Past Life,* Capitol Records 2019. Vinyl LP.

patterns, melodies and timbres, placing an emphasis on the tactile use of MIDI controllers such as launchpads or MIDI keyboards for creativity. This was noted in the literature review and was incorporated into the workflow of this project. In the meeting with the client, it was agreed that the limited studio would dictate the approach to the writing of certain tracks. As there were likely to only be four days in the studio, it was important to have a manageable workload meaning that perhaps one track could have less vocal work to make the timing achievable. Much of the pre-production work was completed in a home studio setting for ease of access for the client, comfortability, and the absence of time pressure.

The mixing of these tracks is the focus of this thesis, so several ground rules were set for this process. For the free mixes, it made most sense to not use any stock plugins that come with DAWs such as Pro Tools or Ableton as this assumes ownership of a paid DAW for a producer attempting to mix tracks without spending money. Using a free DAW was considered for this project however due to the time constraints of learning a new DAW it was a more sensible approach to remove stock plugins. Synthesis was initially a grey area; however, it was decided that these would count as instruments rather than effects as many free synths are available as software instruments and were used in some instances in this project.

When recording in the studio, it was necessary when using hardware equipment for the paid mixes to have a print of the audio recordings with the hardware equipment applied and a print of the audio recordings without the hardware equipment affecting the signal as this was used for the free plugin mixes at the mixing stage of the project.

When evaluating the overall approach, it is clear that some amendments were made. These included the studio time constraints dictating the content of some tracks, or the usage of a paid DAW without stock plugins over a free DAW. Although they sacrifice some potential extra research, these changes were necessary in order for the project to be finished on time. The production plan allowed for appropriate rest in the mixing phase of one or two days for the initial mixes with a limit of four hours and a break of one week between mixes of the same track as the mixes become closer to finishing. As previously mentioned, this greatly improved the quality of the decision making and allowed for a fresh approach both physically and mentally when mixing, which is crucial.

The mixing phase was conducted in *Ableton Live 10 Suite*. The mixing sessions followed best practice in terms of colour coding, track naming and saving in order to make the whole process as professional as possible. For each track the paid mix was created first as this was the most comfortable process and gave a target for the free mix to aim for. When this mix was completed, it was placed in the free mix session as a reference track. The plugins and hardware used in the paid mix served as a guide for what plugins would be needed in the free mixes.

Most professional mix engineers will have one main go-to EQ and roughly between two and four compressor plugins that they trust. This style of workflow was replicated in both mixes. After testing several EQ plugins in the pre-production phase, the chosen plugin was the *TDR Nova* from *Tokyo Dawn Records*. This plugin had similar capabilities and functionality as the *Fab Filter Pro-Q 3* which is an industry standard plugin. The *FETISH* compressor by *Analog Obsession* was used as the main compressor alongside the *TLS 1295 LEA Compressor*. These plugins are emulations of the hugely popular *1176* and *LA-2A* respectively which were referenced in the literature review. Both plugins were tested to see how they fared against the real *1176* and a paid emulation of the *LA-2A* created by *Waves Audio*. Unfortunately, a real *LA-2A* compressor was not available for testing in this project. When searching for freeware emulations of the *Distressor* there were no immediate obvious candidates. A paid version of this plugin does exist created by *Empirical Labs* however the only freeware options appeared to be 32-bit plugins which do not operate on newer *Windows* desktop computers. Some other freeware plugins tested included the *Convergence Multiband Compressor* and *Tape Cassette 2* from *Caleum Audio*.

Overall, careful planning and allowance for creativity were key parts of this research. While there was a tight timeframe there needs to be room for free writing and composing in order to achieve the best possible results. Getting high quality recordings was critical for the mixing phase and pre-production and good guides allowed this to be achieved. Treating each phase of the project as if it were the mixing phase was a helpful approach for this project as it made the client more prepared and at ease when recording and also made the end result much more professional with a lesser workload when it came to mixing the individual tracks.

Analysis

This section will look at the results of comparing free and paid audio plugins and hardware and how the research was aided throughout each phase of production. Conclusions will be drawn in relation to which paid plugins and hardware equipment were effective. It will also be revealed which free plugins performed better than expected and which plugins performed best in terms of time spent versus results. It is important to remember that this research is only representative of one subgenre of music and that these plugins may perform differently in other mix scenarios. However, the research does provide a macro view in terms of ease of use and quality and provides a more in-depth view of how these plugins perform in the context of folk-pop style mixes.

The recording stage of this research was of paramount importance for the success of the mixes. The material was recorded with high quality microphones in a studio environment. The purpose of this was to emphasise the importance of the recording phase of a project and to eliminate an over-reliance on plugins in the mixing stage. By viewing the recording phase as part of the mixing of the track, more focus is placed on proper mic placement and studio best practice thus keeping mistakes are kept to a minimum.

Time spent was a key factor in determining whether a plugin or piece of gear was effective or not. One hardware unit that was extremely effective in this project was the *Empirical Labs Distressor El8X Mono Compressor*. This piece of hardware was available in both studios used in the recording phase of the project. The *Distressor* saved a lot of time and was effective in immediately achieving a professional sounding vocal in particular. This made the paid mix a lot easier to manage once out of the studio as much of the sound was achieved before passing through plugins in the DAW. Confident decision making in the studio led to high quality mixes once it came to the DAW. This was key for the paid mixes. A huge amount of time was saved which allowed for more time to be invested in the free mixes.

Although the mixes are quite sparse at times as is the nature of the genre, arrangement and the careful composition of parts also contributed massively to the mixing of the tracks. By thinking of the mixing phase of the project at each step in the process, less work was left at the end which meant the free plugins were more than effective at achieving professional quality mixes. Microphone choice and placement also allowed for the mixes to work effectively without much masking of frequencies with two or more elements clashing. Careful consideration was undertaken when composing melodies and the instrument choice was critical in order to avoid huge issues in the mixing phase of the project.

When evaluating the success of the free plugins there were many positives including the vast number of options and effectiveness of plugins tested. The main issue identified with free plugins that occurred during the course of this research was the lack of an effective pitch correction plugin. The most effective one tested was *Graillon II*. There was no free plugin available with similar functionality to *Waves Tune* or *Melodyne*. These plugins allow the user to move the notes freely on a piano roll in order for more accurate note snapping to take place. *Graillon II* lacks this feature which means in some cases the vocal can sound robotic. The 'maintain formants' feature on this plugin is very effective in removing the robotic sound however the vocal can become metallic and lack low end as a result. Finding a good balance between the percentage of pitch correction and formant maintaining was key in the case of some of the vocals that were mixed.

While there was a large quantity of both free and paid plugins used throughout the course of this research, it would be remiss not to mention the existence of many more both paid plugins and hardware and free plugins. In particular the series of plugins from *Universal Audio* are extremely popular among many top mix engineers and were not available for testing during the course of this study. While the *FETISH* plugin from *Analog Obsession* was tested and was equally as effective as the *Waves CLA-76*, perhaps it would not be as effective as the *Universal Audio 1176* plugin. The *UREI* hardware *1176* was tested in this project on bass guitar and gave a smooth result quickly. This was achieved also by the *FETISH* plugin from *Analog Audio*; however, it took more time. The main noticeable difference between the hardware and plugin versions of the *1176* compressor was the lack of grit or distortion or in the plugin emulations that is achieved by physical components in the solid-state amplifier that the hardware *UREI 1176* has. However as described earlier, the

average listener has not developed critical listening skills and will not be able to discern these subtle differences, especially on entry level headphones or earphones.

The free plugins performed to a professional standard in the mixing phase. If these plugins were given to a top-level mix engineer with many years more experience, the results would be perhaps even more impressive. However, the same holds true for the paid audio plugins. This was considered throughout the course of the study however these are minute details and are more appropriately targeted at an expert listening audience which is not the purpose of this study.

Discussion

This section will take a look at the learning gained from this project including technical skills and which plugins are deemed essential for purchase. The section will also examine what was achieved and what the project failed to achieve from the writing phase all the way to the mixing stage of the project.

This project placed emphasis on good time keeping and careful planning. *Google Calendar* was used to keep a record of work undertaken and in order to plan dates that suited both parties, especially the client. The studio time was of utmost importance to book early as it can be extremely busy. Four days in total were used for both recording and the usage of outboard equipment. All of this was included as part of the production plan that was established at the beginning of the project. This was updated throughout the year as setbacks such as covid or work schedules made preproduction or mixing days impossible.

Mixing sessions were also stringently planned in order to create the best possible chance for success. The first session for each song was four hours long and mainly focused on naming tracks, colour coding, editing and getting a rough mix of the track created. There were at least three days left in the schedule before working on the same song again. This ensured a fresh approach to the songs each time. The first four-hour block also ensured that the quality of decision making stayed as high as possible. The second mix session for each track mainly focused on making the vocals sound as professional as possible. This session lasted roughly two hours.

A number of technical skills were learned in the process of the mixing of these tracks. For example, the hardware gear was used applied to the tracks after tape as the free mixes could not be affected by the *SSL console* EQ or the outboard compressors and other gear. This meant that proficiency with the signal flow of the studio and patch bay were required. Learning how this outboard equipment worked was part of the learning process. As there was not much prior experience with these pieces of gear, this was some of the key learning undertaken in the project. The same was true for the free plugins used in this project. It was important to learn the limitations and capabilities of each piece of gear and plugin and how they affect the signal.

As mentioned in the analysis section, one of the key takeaways was the lack of a free pitch correction plugin that has the same capabilities as *Melodyne* or *Waves Tune*. For a producer who is budgeting for specific plugins, investing in one of these plugins would be advisable. This is in the case that pitch correction is required. Of course, this could be avoided by more thorough pre-production focusing on getting the vocal melodies perfect. There are also many genres in which perfectly tuned vocals are not expected as the norm. Many DAWs such as Ableton also offer a built-in function to change the cents and semi tone tuning of individual audio clips. While painstaking, this can be effective when used in conjunction with plugins such as *Graillon II* and makes them more useful and less robotic sounding.

While thorough, there is a lot of extra potential in this research. For example, none of the free plugins tested have been used on a drum kit or more uncommonly recorded instruments. It is regretful that the plugins were not tested in more dense guitar heavy mixes for example. However, as alluded to earlier, careful arrangement and writing can inform the mixing process. Once careful planning and thought is put into each phase of recording, there is no reason that the plugins that were tested and successful cannot be used in more dense contexts, particularly by experienced mix engineers.

At the end of the mixing phase, the client was presented with the four tracks mixed twice and asked to do a blind listening test on entry level earphones and headphones. The client chose the paid mix on two of the four occasions commenting that it had a “more polished sound to it”. Interestingly on the track *‘Falling Aimlessly’* which features only a vocal and piano, the client chose the free mix commenting that they didn’t choose the other mix for

this track as the second or free mix sounded “more raw”. It is important to note that the client is not an expert listener and will also perhaps have a different opinion to the average listener as they have heard the tracks many times and will perhaps have some sort of bias towards one mix or another when listening to their own vocal.

Conclusion

Overall, eight mixes total were completed, and each was done to a professional standard. It was established that there is a plethora of options when looking at free plugins that when used correctly, can be just as effective as paid plugins or hardware. As a starting producer, budgeting for a high-quality pitch correction plugin would be strongly advisable. Of those tested, a combination of the built-in cents and semi tone tuning in Ableton and the *Graillon II* plugin was most effective, however still lacking in overall quality. There are many free EQ options that are of high enough quality and the same is true for compressors. Once the mix engineer is familiar with their tools, there is no loss of time spent as many of these plugins allow the user to store presets that can be the foundation for mixing various projects. While there are advantages in terms of sound colouration from hardware equipment, this is not entirely necessary when targeting the average listener. There were many tape emulation and emulations of famous mixing consoles that were available for free that added this colour effectively. The free stereo imager created by *Ozone* was extremely effective when combined with the free reverb from *Valhalla*. By using a free impulse response reverb, the user can also gather free impulse responses or create their own with minimal equipment. This saves the need to invest in a reverb plugin or expensive impulse responses.

There are of course many possible developments and further research opportunities with more time and resources. As mentioned previously, this project is only studying one subgenre and testing the capabilities of this software and hardware in the context of folk based music. There is scope to do the same test with other genres and see how these plugins and hardware pieces perform in a denser mix context. Further study could be done in terms of testing these plugins with a panel of expert listeners. This project was targeted at the average consumer who usually will not be able to tell the subtle differences between the plugins being discussed. Although the mixes for this project were tested on multiple

sound systems including headphones, earphones and studio monitors, it is possible that they may behave differently on other systems such as car speakers or a PA. This could be another avenue for further research.

Appendix A

November: Production plan, plugin downloads, interim thesis work.

Creative time set aside:

Friday – 9am-12pm

Sunday – 9am-12pm

After Thursday November 18th Friday is clear for client pre-production sessions.

December: Arranging, composing, writing and demo recording.

Monday – Thursday solo work.

Friday – Sunday for client pre-production and demo recordings.

December has a particular focus on choosing tempos and writing material.

January: - 1st – 11th Demo work. 11th-31st changes to tracks following group crits and mentor meeting.

February – Recording sessions? Editing, mix ready sessions, 3 days in sun planned for piano and vocal recording.

Early March: Vocal tuning, extra production, extra recording for BVs or guitar? in studio 1 or 2.

Mid-March – April: Mixing and mastering. Hand-up date is May 3rd. April 1st start mixing at the latest. Two days left between revisiting each mix. 8 mixes in total = 16 days. Starting mid-March will allow time for all 8 masters and extra days to revisit mixes of tracks. Free and paid mixes should sound extremely close so mastering shouldn't be drastically different between the free vs paid version of a mix.

Fig 1. Rough timeline which informed the creation of the tracks and mixing dates set aside.

Bibliography

Anthony, B., Mixing As A Performance: Creative Approaches To The Popular Music Mix Process. *Arp*, https://www.arpjournal.com/asarpwp/mixing-as-a-performance-creative-approaches-to-the-popular-music-mix-process/ [Accessed 28 October 2021].

Berardinelli, Carlo. "Audio Digital Signal Processing: Techniques and Applications." UNIVERSITY OF ROMA3, ROME; ITALY, Carlo Berardinelli, 2009, pp. 1–87 https://arcadia.sba.uniroma3.it/handle/2307/501

Bromham, Gary, et al. "The Impact of Audio Effects Processing on the Perception of Brightness and Warmth" The Impact of Audio Effects Processing on the Perception of Brightness and Warmth, 2019, http://davemoffat.com/wp/wpcontent/uploads/2019/09/BrightWarm-AM19.pdf.

De Man, B., 2017. *Towards a better understanding of mix engineering*. Ph.D. Queen Mary University of London. https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/25814/DE%20MAN_Brecht_PhD_Final_090517.pdf?sequence=1&isAllowed=y

LANDR. "The 247 Best Free VST Plugins Ever [2021 Update]." *LANDR*, 21–08-04, blog.landr.com/best-free-vst-plugins.

Maggie Rogers. "Past Life". *Heard It In A Past Life,* Capitol Records 2019. Vinyl LP.

Moore, A., 2017. *AN INVESTIGATION INTO NON-LINEAR SONIC SIGNATURES WITH A FOCUS ON DYNAMIC RANGE COMPRESSION AND THE 1176 FET COMPRESSOR*. PhD. The University of Huddersfield. http://eprints.hud.ac.uk/id/eprint/34118/

Tot, J., 2018. *Multitrack Mixing an Investigation into Music Mixing Practices*. Undergraduate. Staffordshire University. https://www.researchgate.net/publication/324808456_Multitrack_Mixing_An_Investigation_into_Music_Mixing_Practices

Wilson, Alex. “Evaluation and Modelling of Perceived Audio Quality in Popular Music, towards Intelligent Music Production.” *University of Salford*, Alex Wilson, 2017, pp. 1–292. https://usir.salford.ac.uk/id/eprint/43345/1/AlexWilson%20-%20PhD%20Thesis%20-%20FINAL.pdf