Comparing Compressor Interface Designs

How do visual displays on digital compressors impact how audio engineers navigate an interface and the choices they make?

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Audio Technology, bachelor's level
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Luleå University of Technology
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Bachelor Thesis

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Audio Engineering

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Abstract

This research tested to see how audio engineers navigate and use compressors differently with alternative designs. A pre-study in the form of a semi-structured interview with a focus group was held to determine a compressor considered having a “good design” and a compressor considered having a “bad design”. An active test was conducted with audio engineer students to investigate if there is any connection between time it takes for an engineer to navigate a compressor depending on its design. The test also investigated patterns in how audio engineers use compressors differently depending on their design, and what makes it easier to navigate and more satisfactory to use. 6 paired T-test were made between different compressor designs and a video and screen capture was annotated to investigate how audio engineers navigated the compressor. The results showed that 2 out of 6 T-tests gave a significant result, meaning that the time it took to navigate some of the compressors against each other were affected by the design of the compressor interface. Results showed that there are many contributing factor towards why a compressors is easier navigate and more satisfactory to use, but with a slight tendency that “parameter controls”, “visual information” and “aesthetically pleasing” are the most important factors. No findings on how engineers might use compressors differently depending on its design were found. Some additional patterns for audio engineers using compressors were found as well.
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1. Introduction

1.1 Background

Audio engineers will most likely come across all sorts of outboard gear and digital plug-ins. Each of these has different UI’s (User Interface), even the same kind of processor made by different companies has to some extent different UI’s. The differences can be design layouts, knobs, faders, sliders, buttons, text, displays, colors etc. Usability is a term that is used to explain how easy a system might be to use (Lauesen, 2005) and intuitiveness is how something is perceived directly by intuition without any rational thought behind it. Audio systems are no different.

“In the case of the virtual Digital Audio Workstation (DAW) equalizer, the immediacy (and transparency) of the embodiment relationship is displaced by the complexity of the interface design - the experience becomes less through the interface, but of the interface (Johnson 1997)” (Mycroft, 2011, p. 2).

Duignan (2004, via Mycroft, 2016) explains that there is a trend of increasing the visual info on interfaces which has led to interfaces being cluttered and more time consuming. This introduces the question if users are being distracted from the creative part of mixing and processing sounds and are instead being focused on navigating the interface correctly. The interfaces and the visual info presented through them have an impact on how they are being used and what decisions the user will make.

Johannes Röjder’s (2014) research explored how a graphically represented frequency response curve might have an effect on how audio engineers use an equalizer. In his research he found out that audio engineers tend to use wider Q-values and eq higher up in frequency when the graphical response curve is not visible. These results show that there is a connection between how we use digital plugins when the information is visible.

Tidwell (2016) talks about the “preattentive variable” which is something that the mind picks up subconsciously. When a user is presented with graphic models that for example represent data, he or she has already then made an assumption about the underlying data, of the way it’s presented, even before thinking about it consciously. Mental frames are also created within
users. These are perceptual patterns that we create from experiencing the same objects or events in specific situations. These mental frames are occurring subconsciously from situation to situation. This can make us see things that are expected in certain situations that aren’t really there or happening. We just expect them to be there out of habit. The same things are true for interfaces and their layout. If it would be true that most compressors have their threshold knob to the left of the GUI or the front plate, the user’s minds could still be used to the fact that in most cases it is, and therefore change an entirely different parameter then wanted (Johnson 2014).

1.2 The compressors and its parameters

A compressor can be utilized in many different ways. The function of the compressor is designed to be able to shape a signals dynamic content. The compressor is also used as an artistic tool to create unique sounds and timbres in combination with a signal. Many developers implement their own parameters that is unique for their compressor and some developers have different approaches to a compressors parameters, However, a few parameters are recurring on most compressors.

**Threshold:** The parameters sets a value in dBFS. Whenever a signal going through the compressor reaches a value higher that exceeds the set threshold-value, the compressor decreases the signals volume according to the “ratio” parameter.

**Ratio:** The ratio parameter sets how much a signals volume will be decreased each time it exceeds the threshold-value.

**Attack:** Decides how fast the compressor will start to decrease a signals volume after the threshold-value has been exceeded.

**Release:** The time it takes for the compressor to gradually reduce the compression back to its normal state. This happens when a signal falls below the threshold-value.

**Gain:** Increases or decreases the signals volume, and is operating last in the compressors internal chain.

**Knee:** This sets how the compression curve will react. Hard-knee means that there will not be any compression until the signal passes the compressors threshold value. A soft-knee setting gradually starts to compress a signal that approaches the threshold-value.
1.3 Different compressor designs

There are a lot of developers in the industry that implement their own unique functions to their compressors. Different developers also use different labels, units, dials and increments for parameters compared to each other, however, there some of these factors that are most commonly used for compressors. Three examples would be Dynamics III (2018) by Avid, Renaissance Compressor (2019) by Waves Audio and CLA-76 (2019) by Waves Audio (which is a plug-in that emulates both revision d and a of Unviersal Audio’s analog compressor 1176).

Both Dynamic III and CLA-76 uses mostly knobs to set parameters values while Renaissance Compressor uses sliders. The Renaissance compressor and Dynamic III. The Dynamic III have a graphical representation of signal going through the compressor and how the signal is affected by it. The Renaissance Compressor have 3 buttons located at the top of the interface where you can set 3 different modes for the compressor. The CLA-76 uses a parameter labeled “input” instead of a threshold setting. All compressors have attack and release, but whilst Dynamic III have both time and units displayed, Renaissance Compressor have no units displayed, and the CLA-76 just have 1 – 7. To make matters even more confusing, having either the attack or release settings fully turned to the right with the higher numbers, means they are at their fastest settings which the opposite from the Dynamic III. As can be seen, all these different compressor designs are different but also have a lot in common.
1.4 Aim/Purpose

Differences in design layout, etc. mean that the engineer interacts with these UIs differently, and that some may be easier/harder to use for certain tasks, take more time to set parameter values, to learn, etc. This can be evaluated in terms of, for example, usability and intuitiveness. The aim/goal for this proposed study is to investigate factors such as usability, intuitiveness and design layout in digital compressor interfaces, and how the visual design of these UIs affects (or not) how users navigate and use them differently setting the parameters. This research is looking at quite a broad area and is therefore not expecting to present concrete answers. A understanding of the factors of visual displays on digital compressors could lead to them being developed with an improved ease of use, make them less time consuming or just making audio engineers aware of the differences that might appear when mixing with different UI’s.

1.5 Research Questions

The question that is to be pursued is “Comparing compressor interface designs: How do visual displays on digital compressors impact how audio engineers navigate an interface and the choices they make?”. The approach to this topic will be directed more towards the design aspect of the UI rather than the way specific information is visualized.

1.6 Previous Work

Previous work in the field of how visual information impacts the engineer has been done by Josh Mycroft and Johannes Röjder (2014). But in general, the area is quite unexplored and therefore needs further research to see what can be done in the future to improve the design of compressor interfaces.
2. Method

The method for this research consisted of a pre-study and an active test. The main reason for the pre-study was to select two compressors, one considered to have a bad interface design and one considered to have a good interface design, to use for the main active test. Other reasons were to narrow down the 4 – 5 most common parameters found on a compressor, what kind of controls that is preferred for each parameter (dials, knobs, siders etc.), where the parameters would be located on the interface and establish what genres of music the participants usually work with. The reasoning deciding 4 - 5 parameters was that it somewhat narrows the research as well as gives the same conditions for both tested compressor design. The reasoning for establishing a common genre was that the test participants would be familiar with genre to not be distracted with a genre they have never mixed.

The experiment was an active test which consisted of 4 different tests. The test was done in Reaper because of its “UI” feature, which allows for plug-ins to have an alternative interface design. In Test 1 & 2, the goal was to see the time it takes for the participants to set the parameters of the compressors compared to each other, to find out if there were any relevant time differences when they navigated the interface. Test 3 & 4 was designed to see how the test participants navigated the preferred interface and the less preferred interface any differently, and also if they used the compressors any differently. This was done by having the test participants set the two compressors in context to an instrument, and in context to the genre of the stimuli. After the test, they responded to two questions, which of the interfaces that they thought were the easiest to navigate and why? The other question was which interface they thought were the most satisfactory to use and why?

2.1 Target Population

The target population for this research is people who are experienced in using digital plugin compressors. The population includes roles as audio engineers and music producers, who are used to mixing music and using compressors. These roles could especially benefit from discoveries in this area because it could lead to improved digital compressor designs in the future.

The test participants for the active test were all students from Luleå University of technology, the department of arts, communication and education.
2.2 Pre-study

The pre-study was conducted in the form of a semi-structured interview with a focus group of 4 audio engineer students. A JVC GY HM 100 camera filmed the whole interview and a Neumann U89 recorded the sound.

The first part of the interview consisted of questions to the focus group. 4 templates for a plugin outline where drawn on a whiteboard. The participants were first asked to name the most common parameters of a compressor which were written down on the whiteboard (see figure 4) with a number beside them. They were then asked to select 4 – 5 parameters that they expect to find on a compressor (1 – 5 on the whiteboard in figure 4). The participants were asked to draw the number on the template where they would like the parameter to be located, and then choose one of the drawn symbols to represent the control of the parameter which they thought were most appropriate for the parameter (upper right corner, figure 4).

The questions were asked by the focus group leader to obtain information about their thinking when selecting the location and controls for the parameters. Further questions were aimed to extract information about the participants individual preferences when it came to interface design.

In the last part of the interview, the participants were shown pictures of 10 different compressor plugins. They were asked individually to place 5 in a category of prefers and the other 5 in a category of prefers less, they then had to rank each compressor in both categories from 1 – 5, each placement being worth different points.

2.3 Pre-study Analysis

Depending on the ranking from 1 - 5, the compressor plugins were assigned points according to their placement by each participant (see table 1 and 2).
Placements for most preferred
1 = Most preferred
5 = Least preferred

<table>
<thead>
<tr>
<th>Placement</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>5 Points.</td>
</tr>
<tr>
<td>2.</td>
<td>4 Points.</td>
</tr>
<tr>
<td>3.</td>
<td>3 Points.</td>
</tr>
<tr>
<td>4.</td>
<td>2 Points.</td>
</tr>
<tr>
<td>5.</td>
<td>1 Points.</td>
</tr>
</tbody>
</table>

Table 1: The point-system used to decide which compressor that was the most preferred.

Placements for less preferred
1 = Least preferred
5 = Most preferred

<table>
<thead>
<tr>
<th>Placement</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>5 Points.</td>
</tr>
<tr>
<td>2.</td>
<td>4 Points.</td>
</tr>
<tr>
<td>3.</td>
<td>3 Points.</td>
</tr>
<tr>
<td>4.</td>
<td>2 Points.</td>
</tr>
<tr>
<td>5.</td>
<td>1 Points.</td>
</tr>
</tbody>
</table>

Table 2: The point-system used to decide which compressor that was the least preferred.

The points awarded to each compressor were added together and put into two tables, one showing the final ranking and score for the most preferred compressor and one for the least preferred compressor (see table 3).

<table>
<thead>
<tr>
<th>Placement</th>
<th>Most preferred</th>
<th>Least Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CLA-76 (16).</td>
<td>Dyn 3 Compressor (18).</td>
</tr>
<tr>
<td>3.</td>
<td>Renaissance Compressor (9) and Fatso Jr (9).</td>
<td>Waves C1 (12).</td>
</tr>
<tr>
<td>4.</td>
<td>-</td>
<td>Fatso Jr (4).</td>
</tr>
</tbody>
</table>

Table 3: The parenthesis shows that final points awarded for the compressor.

CLA-76 (preferred) and Dyn3 (less preferred) was awarded the highest scores, these were however excluded. The reason for Dyn3 was that the only program it was compatible with is Pro Tools, which have no options of changing the UI without the knowledge of programming.
The reason for excluding CLA-76 was that the names of its parameters are unusual compared to the majority of other compressors, neither does it have any information to indicate what kind of units the different parameters operate in. This led to FabFilter Pro-C2 (2nd place) being elected to use as the most preferred compressor and ReaComp (2nd place) as the least preferred compressor. Both of these had the same parameters that was needed to perform to compare them against each other. The parameters that were chosen were the following: 
Attack, release, ratio and threshold.

The video recording from the pre-study was annotated to decide which genre of music that would be chosen for the stimuli and which type of instrument. The most common instrument the participants used compressors for was vocals and the genre they mixed most of the times was pop/rock.

![Figure 5: The compressor elected as the least preferred compressor design, ReaComp (See”Appendix C” for a bigger picture).](image-url)
2.4 Creating the Stimuli

The stimuli were created in Pro Tools 12. Excerpts from two previous professional studio recordings were elected to for the stimuli. From the first one a vocal track and a guitar track playing a verse from a cover of the song called “Plain Jane Heroin” by “Theo Katzman”, and the other one a piano and vocal track playing a verse from a cover of the song “A thousand miles” by “Vanessa Carlton”. The guitar and piano were both chosen because they were especially important instruments in their respective song, in this case, meaning that the vocals are dependent on them from a music production perspective. Both vocal tracks were left unprocessed. The piano and guitar were processed with an EQ and a compressor to sound similar to the original recordings.

2.5 The Active Test Tools

The test was conducted in G – 113 at Musikhögskolan i Piteå. The test was done on an iMac computer with Reaper. An RME Babyface audio interface was connected to the computer with 2 Genelec 1030a to the outputs. All of the participants facial expressions were recorded.
with a JVC GY-HM 100U camera during each test, and the screen of each test was also recorded with QuickTime. A paper with written instructions for each test was provided for the test participants (see “Appendix K”). Each test participant would either do an A or B version of each test which was randomized by rolling a six-sided die before each test (1 – 3 test A, 4 – 6 test B). In the test, they were allowed to use both the mouse and the keyboard.

2.6 The Active Test

In Test 1 & 2, no sound was provided (see figure 8). The test participant was asked to set 1 pre-chosen value for 4 different parameters, attack, release, ratio and threshold on two different compressors. The differences between Test 1 & 2 was that in Test 1 the compressors original designs were used and in Test 2, Reapers “UI” function was activated which changes the original compressor design to sliders (see figure 9 & 10). The compressors were inserted as an “FX” in Reaper on 2 two different tracks (Track A and Track B), with one of the compressors on “Track A” and the other on “Track B). The values were shown on the written instructions that was provided with a large font size and bold letters so it would be easy for the participant to locate the values written down in the text.

The values asked for did not have to be the exact values that was written in the text, but close enough according to the test.
participant standards. The reasoning for not demanding exact values, depends on the difficulty to make small increments within the plugins if the test participant chose to use the mouse (it is obviously not a problem with the keyboard).

Each participant was asked to start with “Track A”. When the participant was ready to start the test, they were asked to press “Start” on an iPad with a stopwatch application. When the button was pressed, the test conductor displayed the compressor and the test participant could start to fill in the values asked for.

When the test participant had dialed in all the parameter values asked for, they had to press “Stop” on the iPad to stop the test. The time taken to dial in the parameter’s values were documented. The test conductor then resets the timer on the iPad and the test participant was now asked to dial in new values for the compressor on “Track B”.

In Test 3 & 4 the test participant was asked to compress a vocal track from a rock/pop recording against an instrument from the same session (Test 3 guitar, Test 4 piano). Their goal was to compress the vocal track so that they think it is fitting genre-wise and in context to the instrument. They were allowed to change the volume on the audio interface (RME Babyface) as they wanted during the test. This decision was taken because it would have no impact on the test participants navigation. each participant was told to start with “Track A”. The parameters they were allowed to use was “Attack, Release, Threshold, Ratio and Gain/Wet mix. When they were satisfied with their results, they were
asked to press “Stop” on the iPad and inform the test leader. The timer on the iPad was reset and the new goal for the test participant was to try to mimic the compression on “Track A” with the compressor on “Track B”, without being allowed to listen to “Track A” or look at the compressors setting on the “Track A”. After the test was done, the participant was asked to fill in a questionnaire (See “Appendix L”). The questions were designed to find out which compressor design the participants preferred in terms of navigation and how satisfying it was to use. Follow up questions asked the participants to describe why they preferred the chosen compressor design.

2.7 Editing the Video Material

The screen capture and video recordings were exported into iMovie. In iMovie, both files were put in a split screen and the both recordings were synced with each other. This made it possible to analyze both recordings simultaneously, which showed the whole process of the participants workflow in context to each other.

2.8 Paired T-tests

Several paired T-tests were used to analyze the results. Each individual participants results were compared against each other in every combination, this resulted in 6 different T-tests.

2.9 Demographic Data

Figure 12: A graph showing the distribution of what year the participants are studying.
Figure 13: A graph showing the distribution of the participants experience with pop and rock mixing.

Figure 14: A graph showing the distribution of the participants experience using Reaper.
3. Results and Analysis

In total, there were 18 students who participated in the test, 4 were excluded because of technical issues that made them invalid. The participants that were excluded were 1, 2, 3 and 4.

3.1 Results for Test 1 & 2

6 separate paired T-tests have been used to see if there is a significant difference between the time taken to dial in the compressors. Each compressor has been compared against each other with a separate paired T-test. This is to determine if there is any significant difference between the time it takes to dial in the settings on a compressor depending on its design (see table 5).

**Null Hypothesis (H₀)** - There is no significant difference for the time it takes an audio engineer, navigate this specific compressor compared to another compressor, that is dependent on its design.

**Alternative Hypothesis (H₁)** - There is significant difference for the time it takes an audio engineer, to navigate this specific compressor compared to another compressor, that is dependent on its design.
<table>
<thead>
<tr>
<th>Participant nr.</th>
<th>Time taken (h:m:s)</th>
<th>Participant nr.</th>
<th>Time taken (h:m:s)</th>
<th>Participant nr.</th>
<th>Time taken (h:m:s)</th>
<th>Participant nr.</th>
<th>Time taken (h:m:s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>00:00:24</td>
<td>5.</td>
<td>00:00:37</td>
<td>6.</td>
<td>00:00:39</td>
<td>4.</td>
<td>00:00:24</td>
</tr>
<tr>
<td>5.</td>
<td>00:00:37</td>
<td>6.</td>
<td>00:00:39</td>
<td>7.</td>
<td>00:00:33</td>
<td>5.</td>
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</tr>
<tr>
<td>6.</td>
<td>00:00:39</td>
<td>7.</td>
<td>00:00:22</td>
<td>8.</td>
<td>00:00:38</td>
<td>6.</td>
<td>00:00:17</td>
</tr>
<tr>
<td>7.</td>
<td>00:00:33</td>
<td>8.</td>
<td>00:00:40</td>
<td>9.</td>
<td>00:00:43</td>
<td>7.</td>
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</tr>
<tr>
<td>8.</td>
<td>00:00:38</td>
<td>9.</td>
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</tr>
<tr>
<td>9.</td>
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<td>11.</td>
<td>00:01:10</td>
</tr>
<tr>
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<td>14.</td>
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<td>12.</td>
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</tr>
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<td>13.</td>
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<td>14.</td>
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<td>00:01:20</td>
<td>19.</td>
<td>00:00:35</td>
<td>17.</td>
<td>00:00:47</td>
</tr>
<tr>
<td>18.</td>
<td>00:00:48</td>
<td>19.</td>
<td>00:01:20</td>
<td>20.</td>
<td>00:00:35</td>
<td>18.</td>
<td>00:00:58</td>
</tr>
</tbody>
</table>

**Table 4**: Table over the time taken for each participant for each separate compressor.

**Degrees of Freedom** = 13

**The Level of significance** = 0.05
### Compressor comparison

<table>
<thead>
<tr>
<th>Compressor comparison</th>
<th>T-value</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReaComp Original vs FabFilter Pro-C2 - Original</td>
<td>0.7070</td>
<td>T-value is under 95%, $H_0$ is therefore accepted</td>
</tr>
<tr>
<td>ReaComp Original vs ReaComp Sliders</td>
<td>0.2405</td>
<td>T-value is under 95%, $H_0$ is therefore accepted</td>
</tr>
<tr>
<td>ReaComp Original vs FabFilter Pro-C2 - Sliders</td>
<td>3.506</td>
<td>T-value is over 95%, $H_A$ is therefore accepted</td>
</tr>
<tr>
<td>FabFilter Pro-C2 – Original vs FabFilter Pro-C2 - Sliders</td>
<td>0.769</td>
<td>T-value is under 95%, $H_0$ is therefore accepted</td>
</tr>
<tr>
<td>FabFilter Pro-C2 – Original vs ReaComp - Sliders</td>
<td>0.4708</td>
<td>T-value is under 95%, $H_0$ is therefore accepted</td>
</tr>
<tr>
<td>ReaComp – Sliders vs FabFilter Pro-C2 - Sliders</td>
<td>2.307</td>
<td>T-value is over 95%, $H_A$ is therefore accepted</td>
</tr>
</tbody>
</table>

*Table 5: Each compressor paired against one another*

Out of 6 different T-tests, 2 were concluded to have a level of significance at 95% or higher. The ReaComp original compared to the FabFilter Pro-C2 – Sliders had a T-value that was over 99%.

### 3.2 Video Material Analysis Test 1 & 2

The video material for Test 1 & 2 was analyzed by writing comments on how the participants were interacting with the compressors individually showed a pattern for both the ReaComp and the FabFilter Pro-C2.

**ReaComp - Original:** 11 out of 14 participants were searching with the mouse over the screen to find the threshold-parameter. The majority of participants were searching with the mouse for the “threshold-parameter” in the middle of the ReaComp interface”. 1 of the participants instead changed the parameter for “knee” instead of threshold-parameter. 7 out of 14 participants started to use the mouse to drag the sliders but then changed over to the keyboard instead. For the final count, 11 out of 14 participants were using the keyboard to write the parameter values.

**FabFilter Pro-C2 –** 5 out 14 participants had problems to dial in the asked for value with the ratio-parameter and 4 out 14 had problems to dial in the release-parameter.
12 out of 14 participants used the mouse to dial in the parameters of the compressor. The participants that used the keyboard had no problems to set the ratio.

ReaComp – Slider: There seemed to be no problems for the participants to dial in the parameter values for ReaComp – Slider.

FabFilter Pro-C2 – Slider: 5 out of 14 had problems to dial in the asked for values with the ratio-parameter and 4 out 14 had problem to dial in the release-parameter, 2 comments in total were also made when the design was exposed.

“damn, that is alot” - participant 9
” O dear lord” - participants 16

3.3 Results for Test 3 & 4

Figure 15: Percentage over the choice which the participants found easiest to navigate. The question asked was “Which one of the compressors do you think was the easiest to navigate?.”
The answers by each participant was analyzed. This was done by first establishing a number of positive categories, based on each different aspect of the design mentioned in answers 4.1 and 5.1 by the participants (Table 7). All the individual comments were categorized as can be seen in “Table 8 & 9”. A point was given to the category each time a comment by a participant revolved around that certain design aspect. Only 1 point would be assigned to a category by each individual answer, the histogram shows how many times the answers by the participants were put in each category (see Figure 17).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Surveyability</th>
<th>Parameter Controls</th>
<th>Visual Information</th>
<th>Intuitive</th>
<th>Ease of Use</th>
<th>Previous Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchored in Reality</td>
<td>Anchored in Reality</td>
<td>Graphics</td>
<td>Few Distractions</td>
<td>Aesthetically Pleasing (5.1)</td>
<td>Contrast Between Background and Parameters (4.1)</td>
<td>Placement of Parameters</td>
</tr>
</tbody>
</table>

*Table 7 The parenthesis (4.1) is a specific category for question 4.1 and (5.1) for question 5.1*
The same categories were used for both the answers to question 4.1 and 5.1, because most answers from the participants were overlapping, and giving the same reasons for why they preferred it. The exceptions were “Contrast between background and parameters” and “intuitive”, which were specifically mentioned in answers for question 4.1. The answers for question 5.1 presented a new category as well, which is referred to as “Aesthetically pleasing”. A translated transcript of the answers can be seen in “Table 8” and “Table 9”.

<table>
<thead>
<tr>
<th>Preferred Compressor</th>
<th>Answers for Questions 4.1 (Which one of the compressors do you think was the easiest to navigate in?)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>The GUI feels more transparent</td>
<td>Surveyability</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Contrast between background and controls. Large distinct controls</td>
<td>Contrast between background and parameters, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Easier interface. It has a better connection to real analogue outboard gear</td>
<td>Easier to understand, Anchored in reality</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>Prefer faders/sliders</td>
<td>Parameter controls</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>The parameters respond more as I expected them to: ReaComp</td>
<td>Intuitive, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It had the graphics which was very &quot;informative&quot;</td>
<td>Visual information, Graphics</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>I have used it many times before. Therefore I felt more comfortable with it</td>
<td>Previous experience</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It is somewhat easier to mix when one mixes with the eyes- easier to see what happens in Fabfilter</td>
<td>Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It was more visual and gave more visual reactions based on my settings</td>
<td>Visual Information</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>The interface was easy to understand. Not many distractions (for example. Fabfilters background).</td>
<td>Intuitive, Few Distractions</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Good Interface</td>
<td>Surveyability</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It has knobs instead of sliders like in ReaComp, and the controls are places in a more logical way</td>
<td>Parameter controls, Placement of parameters</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>More responsive to use knobs instead of sliders</td>
<td>Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>I liked that you saw the sound and how it was affected by the compressor</td>
<td>Visual information</td>
</tr>
</tbody>
</table>

Table 8: The category system to code each participant’s comment in to a category for question 4.1, see “Appendix I” with the original Swedish transcript of the comments.
Figure 17: The histogram shows how many times a category was mentioned, as being why the chosen participant thought the compressor was easier to navigate.
<table>
<thead>
<tr>
<th>Preferred Compressor</th>
<th>Answers for Questions 5.1 (Which compressor do you think was the most satisfactory to use?)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>The GUI, Which was mentioned earlier. The realtime graph/meter made it easy to see what you were doing</td>
<td>Surveyability, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Aesthetically appealing &quot;sluggish&quot; controls. Big movements with the mouse are required for fine tuning</td>
<td>Aesthetically pleasing, Parameter control</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>More connected to how it looks in reality</td>
<td>Anchored in reality</td>
</tr>
<tr>
<td>ReaComp - Slider</td>
<td>Prefer to not see how the compressor is affecting visually</td>
<td>Few distractions</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>It felt more flexible to dial in the sound I wanted. It is also nice to clearly see the Gainreduction</td>
<td>Ease of use, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It had the graphics which was very “informative”</td>
<td>Graphics, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It looks the best and I am used to use it</td>
<td>Aesthetically pleasing, Previous experience</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>More good looking design. + what I said in the previous answer (4.1)</td>
<td>Aesthetically pleasing, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>I got to see what I was doing as well as the sound</td>
<td>Visual information</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>The meter shows Gainreduction in a good way. Threshold displays the sound (Hence you see how much the compressor is affection the sound)</td>
<td>Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Good interface, Good visualizations</td>
<td>Surveyability, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>It has knobs instead of sliders like in ReaComp, and the controls are places in a more logical</td>
<td>Parameter control, Placements of parameters</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Listened more when I was using the slider version. But Fabfilter’s original interface was easier to manage</td>
<td>Ease of use</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Some of the sliders were hard to control- I thought the dials were easier to manage</td>
<td>Parameter controls</td>
</tr>
</tbody>
</table>

*Table 9: The category system to code each participant’s comment in to a category for question 5.1, see “Appendix J” with the original Swedish transcript of the comments.*
Figure 18: The histogram shows how many times a category was mentioned, as being why the chosen participant thought the compressor was most satisfactory to use.

In the answers for question 4.1, “parameter controls” (2nd place) and “visual information” (1st place) were the parameters that were mentioned most of the times. In the answers for question 5.1, “parameter controls”, “visual information” and “aesthetically pleasing” mentioned most times.

3.4 Video Material Analysis Test 3 & 4

Most participants seem to use the interfaces similarly regardless of which one that were used. One thing that was noted is that some engineers set the attack, ratio and release very similarly for each different test. What could also be seen was that some participants dragged the parameters between the maximum and minimum value.
4. Discussion

In test 1 and 2, the T-test gave a result that 2 out of 6 of the comparisons had a level of significance that was 95% or higher. This means that some aspect on the design is having an effect on how audio engineers navigates the different compressors. This could depend on many factors. A plausible cause is the orders of which the parameters are presented on the ReaComp and FabFilter Pro-C2 in their “UI” mode. The reason then for the FabFilter Pro-C2 – slider taking longer to dial then the ReaComp would be that the order that the parameters are presented in is somehow distracting the participants. The amount of the parameters could also be a factor. FabFilter Pro-C2 - have a lot more parameters then ReaComp thus making it overwhelming. Two comments from test participants (See “FabFilter Pro-C2 – slider under 3.4) were also documented when they were first presented with the Fabfilter. Pro-C2 – Slider. These were comments that could have been the participants being overwhelmed by all the parameters. What needs to be investigated further is what factors in the design that have this effect on the navigation.

Both FabFilter Pro-C2 and ReaComp had a function where it was possible to write in the values, but only 2 participants used this function for the FabFilter Pro-C2, while only 3 used the mouse to drag the sliders for the ReaComp. This can depend on many different reasons. An argument could be that 2nd most named category for why the FabFilter Pro-C2 were easier to navigate and more satisfactory to use, were because of its parameter controls. The engineer might then be more tempted to use the parameter controls because they were more responsive. It could also be that the sliders did not respond as the majority of engineers in the test were expecting, which might explain why half of them started to use the mouse to drag the sliders, but then changed to the keyboard to write in the parameter values.

The majority of participants had a hard time to find the “threshold-parameter” on the ReaComp which might also be a contributing factor towards why it was not preferred by the majority.

The chosen instruments used for the stimuli will have had an impact on how an engineer use a compressor to process them. Most audio engineers will set compressors differently for different instruments depending on how dynamic they are and personal preferences. This will therefore have affected the participants in this research as well. However, because the same instruments were used in each individual test without any comparison between test 3 & 4,
and the conditions that changed for each individual test were the design, the instrument used in this research, should therefore be irrelevant for testing the impact on different compressor designs and how engineers use them. The order of the design was also randomized, which further strengthens the argument.

In the video material, a few different ways of mixing could be observed that the compressor design did not have any effect on. One of these ways were that some audio engineers started to set the attack, ratio and release at the same values for every compressor design in Test 3 & 4. These candidates seldom went back to adjust the parameter afterwards and continued to use the threshold as a way of setting the amount of compression. This could suggest many different scenarios, for example: this individual did not listen to the track and instead has a pre-decided parameter setting for those specific parameters they often use, do not understand the exact function of the parameters, do not hear perceive any difference in the sound, or do not think adjusting them have any impact on the final result. Some participants dragged the parameter controls slowly between maximum value and minimum a few times. This suggest that they are listening to how the compressor is working.

It is hard to draw any conclusions based on the results from the answers in the question 4.1 and 5.1, because many of the answers are scattered among different design aspects what made the interfaces easier to navigate and more satisfactory to use. However, there are some aspects in the design that seem more important for the user such as parameter controls and visual information.

“intuitive” and “contrast between background and parameters” is mentioned in the answers for question 5.1, and “aesthetically pleasing” in the answers for question 4.1. These aspects therefore seem to be unique for navigation and satisfactory use.

No findings were made regarding how audio engineers might use the compressor differently depending on its design. In general, most participants had a certain order they engaged with the parameters.
4.1 Critique and Future Research

The research area might have been a little too broad and would have required more time to investigate or rather look at a more specific area. The information collected for the research is very spread out and can lead to it being hard follow.

More demographic data could have been used to see if participants that mix other genres of music have any different preferences when it comes to design aspects. This data should also include if the user’s had experience with any of the chosen plugins.

In the future, it would be interesting to investigate if engineers navigate differently depending on what kind of controls the parameters have. It would also be interesting to see a research being done on what kind of visual information that is preferred for audio engineers when using compressors, and see if there is any “aesthetic elements” that are preferred for compressors.

4.2 Conclusion

This bachelor thesis investigated a very broad area which can hopefully be used as a basis for future research in the area of interface design. The research question pursued the task of investigating the design of digital compressors and how it impacts how audio engineer’s navigates it and the choices they make. The results showed data suggesting that the interface design had a significant impact on how engineers navigate them. Visual information and parameter controls were the categories that participants most often considered made the interface easier to navigate, and most satisfactory to use. Order of the parameters and number of parameters also might be contributing factors to navigation and how satisfactory a compressor is to use. Further research regarding these design aspects needs to be investigated, to confirm if they have any connection to how easy a compressor is to navigate and how satisfactory it is to use.

4.3 Acknowledgements

I would like to thank everyone that contributed to this test by partaking in the active test and pre-study, my classmates for all the necessary feedback through seminars to improve my work, and my friend Oskar Bergkvist, who have been helping me setting up the active test as
well as being very supportive. A special thanks to my supervisor Nyssim Lefford, who have been helping me out immensely during the whole process, and being inspiring to help me push forward all the way over the finish line.
References


Appendix A – Pre-study Whiteboard
Appendix B – Most Preferred Compressor, FabFilter Pro-C2
Appendix C – Least Preferred Compressor, ReaComp

[Image of ReaComp software interface]
Appendix D – ReaComp – Slider
## Appendix E – FabFilter Pro-C2 - Slider

![FabFilter Pro-C2 Slider Settings](image)

- **Style**: Clean
- **Threshold**: -18.00 dB
- **Ratio**: 4:00:1
- **Knee**: +18.00 dB
- **Range**: +50.00 dB
- **Attack**: 0.25 ms
- **Release**: 200.2 ms
- **Auto Release**: Off
- **Lockahead**: 0.00 ms
- **Hold**: 0.00 ms
- **Wet Gain**: 0.00 dB
- **Wet Pan**: Mid: 0 dB / Side: 0 dB
- **Dry Gain**: -INF dB
- **Dry Pan**: Mid: 0 dB / Side: 0 dB
- **Auto Gain**: On
- **Side Chain Mode**: Off
- **Side Chain Input**: Input
- **Stereo Link**: 100%
- **Stereo Link Mode**: Mid
- **Side Chain Low Enabled**: Disabler
- **Side Chain Low Frequency**: 100.00 Hz
- **Side Chain Low Slope**: 24 dB/oct
- **Side Chain Mid Auto**: Auto
- **Side Chain Mid Enabled**: Enabled
- **Side Chain Mid Frequency**: 1000.0 Hz
- **Side Chain Mid Gain**: 0.00 dB
- **Side Chain Mid Q**: 1.000
- **Side Chain Mid Shape**: Bell
- **Side Chain High Enabled**: Disabler
- **Side Chain High Frequency**: 6000.0 Hz
- **Side Chain High Slope**: 24 dB/oct
- **Audition Side Chain**: Off
- **Audition Triggering**: Off
- **Mix**: 100.0%
- **Input Level**: 0.00 dB
- **Input Pan**: Left: 0 dB / Right: 0 dB
Appendix F – CLA-76
Appendix G – Dynamic III
Appendix H – Renaissance Compressor
Appendix I – Transcript of Answers for Question 4.1

<table>
<thead>
<tr>
<th>Preferred Compressor</th>
<th>Answers for Questions 4.1 (Which one of the compressors do you think was the easiest to navigate in?)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>GUI:n känns mer överskådlig</td>
<td>Surveyability</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Kontrast mellan bakgrund och kontroll. Stora tydliga reglage</td>
<td>Contrast between background and parameters, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Enklare interface. Det har bättre koppling till verkliga analoga burkar</td>
<td>Easier to understand, Anchored in reality</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Kontrast mellan bakgrund och kontroll. Stora tydliga reglage</td>
<td>Contrast between background and parameters, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Enklare interface. Det har bättre koppling till verkliga analoga burkar</td>
<td>Easier to understand, Anchored in reality</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Kontrast mellan bakgrund och kontroll. Stora tydliga reglage</td>
<td>Contrast between background and parameters, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Enklare interface. Det har bättre koppling till verkliga analoga burkar</td>
<td>Easier to understand, Anchored in reality</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Kontrast mellan bakgrund och kontroll. Stora tydliga reglage</td>
<td>Contrast between background and parameters, Parameter controls</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Enklare interface. Det har bättre koppling till verkliga analoga burkar</td>
<td>Easier to understand, Anchored in reality</td>
</tr>
</tbody>
</table>
### Appendix J – Transcript of Answers for Question 5.1

<table>
<thead>
<tr>
<th>Preferred Compressor</th>
<th>Answers for Questions 5.1 (Which compressor do you think was the most satisfactory to use?)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>GUI’n, som nämndes tidigare. Realtids grafen/mätaren gjorde det lätt att se vad man gjorde</td>
<td>Surveyability, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Estetiskt tilltalande “Tröga” reglage. Stora musrörelser krävs för småjusteringar</td>
<td>Aesthetically pleasing, Parameter control</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Mer kopplat till hur det ser ut i verkligheten</td>
<td>Anchored in reality</td>
</tr>
<tr>
<td>ReaComp - Slider</td>
<td>Föredrar att inte se hur kompressorn påverkar visuellt</td>
<td>Few distractions</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>Det kändes smidigare att ratta in det ljud jag ville ha. Sen är det även najs att tydligt se Gainreduction</td>
<td>Ease of use, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Den hade grafiken som var väldigt “informativ”</td>
<td>Graphics, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Den ser bäst ut och är van vid att använda den</td>
<td>Aesthetically pleasing, Previous experience</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Snäggare design. + det jag sa i förra svaret (4.1)</td>
<td>Aesthetically pleasing, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Jag fick se vad jag gjorde samt ljudet</td>
<td>Visual information</td>
</tr>
<tr>
<td>ReaComp - Original</td>
<td>Mätaren visar gain reduction på ett bra sätt. Threshold visar ljudet (därav ser man hur mycket kompressorn påverkar ljudet</td>
<td>Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Bra interface, Bra visualiseringar</td>
<td>Surveyability, Visual information</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Den harr rattar istället för sliders som I ReaComp och kontrollerna är placerade på ett mer logiskt vis</td>
<td>Parameter control, Placements of parameters</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Lyssnade mer när jag använde slider versionen. Men fabfilter original interface var mer lätt hanterligt</td>
<td>Ease of use</td>
</tr>
<tr>
<td>FabFilter Pro-C2 - Original</td>
<td>Vissa av sliders var svåra att kontrollera- Tyckte rattarna kändes mer lätt hanterliga</td>
<td>Parameter controls</td>
</tr>
</tbody>
</table>
Appendix K – Tests Written Instructions

Test 1

Exempel A

Testet kommer gå till på följande sätt: Du ska ställa in de parametervärdena angivna i fetstil nedan så nära som möjligt på kompressorn på spåret ”Kompressor A”. När du är redo att påbörja testet trycker du ”start” på tidtagaruret på iPaden, då trycker testledaren fram kompressorn för spåret som heter ”Kompressor A”. När du har ställt in de angivna parametrarna trycker du ”stop” på tidtagaruret på iPaden.

Ratio: 30:1

Attack: 120ms

Release: 250ms

Threshold: -26dB
Exempel B

Du ska ställa in de parametervärdena angivna i fetstil nedan så nära som möjligt på kompressorn på spåret ”Kompressor B”. När du är redo trycker du på start på tidtagaruret på iPaden och då trycker testledaren fram kompressorn för spåret ”Kompressor B”. När du har ställt in de angivna parametrarna trycker du på stop tidtagaruret på iPaden.

**Ratio:** 31:1

**Attack:** 80ms

**Release:** 300ms

**Threshold:** -17dB
Test 2

Exempel A

Testet kommer gå till på följande sätt: Du ska ställa in de parametervärdena angivna i fetstil nedan så nära som möjligt på kompressorn på spåret ”Kompressor A”. När du är redo att påbörja testet trycker du ”start” på tidtagaruret på iPaden, då trycker testledaren fram kompressorn för spåret som heter ”Kompressor B”. När du har ställt in de angivna parametrarna trycker du ”stop” på tidtagaruret på iPaden.

Ratio: 40:1

Attack: 10ms

Release: 550ms

Threshold: -10dB
Exempel B

Du ska ställa in de parametervärdena angivna i fetstil nedan så nära som möjligt på kompressorn på spåret ”Kompressor B”. När du är redo trycker du på start på tidtagaruret på iPaden och då trycker testledaren fram kompressorn för spåret ”Kompressor B”. När du har ställt in de angivna parametrarna trycker du på stop tidtagaruret på iPaden.

**Ratio: 25:1**

**Attack: 15ms**

**Release: 170ms**

**Threshold: -35dB**
Test 3

I test 3 kommer du att få ställa in parametrarna på två olika kompressorer för två sångspår ("Kompressor A" och "Kompressor B") med en elgitarr som backing track. Börja med "Kompressor A"

**Kompressor A**

Du ska ställa in parametrarna på "Kompressor A" så att du tycker att sången passar till genren och i kontext till elgitaren. Tryck ”start” på tidtagaruret på iPaden när du är redo och börja med att ställa in parametrarna på kompressorn. Följande parametrar är tillgängliga att använda:

**Threshold, Attack, Release, Ratio, Gain/Wet Mix.**

När du är nöjd med resultatet och dina inställningar för ”Kompressor A”, tryck ”stop” på tidtagaruret på iPaden och meddela testledaren.

**Kompressor B**

Du kommer nu få komprimera samma sångspår med en annan kompressor. Försök att efterlikna inställningarna för ”Kompressor B” efter de på ”Kompressor A”. **Du får inte återgå och lyssna på varken spåret ”Kompressor A” eller titta på dess kompressors inställningar.** Starta tidtagaruret på iPaden när du är redo. Följande parametrar är tillgängliga att använda:

**Threshold, Attack, Release, Ratio, Gain/Wet Mix.**

När du är nöjd med resultatet och dina inställningar för ”Kompressor B”, tryck ”stop” på tidtagaruret på iPaden och meddela testledaren.
Test 4

I det sista testet (test 4) kommer du få komprimera nya sångspår ("Kompressor A" och "Kompressor B") med ett piano som backing track. Originalgränssnitten av kompressornas har bytts ut mot reglar/sliders. Börja med "Kompressor A".

**Kompressor A**

Ställ in parametrarna på "Kompressor A" så att du tycker sången passar till genren och i kontext till pianot. Tryck ”start” på tidtagaruret på iPaden när du är redo och börja med att ställa in parametrarna på kompressorn. Följande parametrar är tillgängliga att använda:

**Threshold, Attack, Release, Ratio, Gain/Wet Mix.**

När du är nöjd med resultaten och dina inställningar för "Kompressor A", tryck ”stop” på tidtagaruret på iPaden och meddela testledaren.

**Kompressor B**

Du kommer nu få komprimera samma sångspår med en annan kompressor. Försök att efterlikna inställningarna för "Kompressor B" efter de på "Kompressor A". **Du får inte återgå och lyssna på varken spåret "Kompressor A" eller titta på dess kompressors inställningar.** Starta tidtagaruret på iPaden när du är redo. Följande parametrar är tillgängliga att använda:

**Threshold, Attack, Release, Ratio, Gain/Wet Mix.**

När du är nöjd med resultaten och dina inställningar för "Kompressor B", tryck ”stop” på tidtagaruret på iPaden och meddela testledaren.
Appendix L – Test Questionnaire

Testperson nr. __________

1. Vilket år ljudteknik studerar du?
   - [ ] År 1
   - [ ] År 2
   - [ ] År 3

2. Har du tidigare erfarenhet av att använda Reaper?
   - [ ] Jag har aldrig använt det
   - [ ] Jag har använt det ett par gånger, men använder det inte regelbundet
   - [ ] Jag vet hur man använder det och använder det ibland
   - [ ] Jag använder Reaper regelbundet

3. Hur ofta mixar du rock eller popmusik?
   - [ ] jag mixar nästan aldrig pop/rock
   - [ ] Jag mixar pop/rock ett par gånger varje år
   - [ ] Pop/rock musik är det jag mixar mest och jag mixar pop/rock musik ofta
   - [ ] Annat/Förklara

___________________________________________________________________________

___________________________________________________________________________

4. I test 3 & 4, vilken av kompressorerna tycker du det var lättast att navigera i?
   - [ ] ReaComp - original design
   - [ ] FabFilter Pro-C2 - original design

4.1 Vad gjorde den lättast att navigera i?
5. I test 3 & 4, vilken av kompressornas design var mest tillfredsställande för dig att använda?

☐ ReaComp - original design
☐ ReaComp - med sliders
☐ FabFilter Pro-C2 - original design
☐ FabFilter Pro-C2 - med sliders

5.1 Vad gjorde den mest tillfredsställande att använda?