

Empirical Evaluation of Listener Identification and Preference for Analogue Modelling Versus Non-Modelling Plugins in Audio Mixing

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This study examines the perceptual differences between music mixed with paid analogue-modelling plugins and free non-modelling plugins, within the context of typical music consumption. To explore this, a blind AB test was conducted and featured in a YouTube video, with uncompressed 24-bit, 44.1 kHz audio files additionally provided via a link in the pinned comment. 514 participants assessed two mix versions of a song. One version, the “analogue mix,” utilised 49 instances of paid analogue-modelling plugins from reputable manufacturers, while the other, the “digital mix,” was matched to the first using only free non-modelling plugins. The primary objective was to determine whether listeners could accurately identify the analogue mix and if there was a preference for it. Statistical analysis of survey responses revealed a significant tendency to misidentify the analogue mix ($p < 0.004$) and no statistically significant preference for the analogue mix ($p > 0.58$).

Keywords: analogue modelling plugins, blind AB test, ITB mixing

1. Introduction

In the field of audio engineering, the merits of analogue modelling plugins remains a subject of debate. With their significantly lower cost compared to traditional studio hardware and the advantage of supporting unlimited plugin instances, analogue modelling plugins have quickly become everyday tools for many contemporary audio engineers. Yet free non-modelling plugins generally tend to accomplish the same kinds of tasks as traditional studio hardware and their modelled plugin counterparts, often with wider parameter ranges and additional features that were not available using the original hardware. Adjectives such as *authentic*, *vintage*, *warm*, *colourful*, *rich*, *smooth*, *classic*, *fat* are routinely used by plugin manufacturers to differentiate their plugins from

non-modelling plugins with a similar function, sometimes negatively characterising the latter as *cold*, *sterile*, *harsh*, *thin*, *flat*, *grainy*, *artificial*, *one-dimensional*. Such descriptions invite prospective customers of their plugins to believe they will achieve superior results in their own mixes as a result of these claimed markedly superior sonic attributes. This raises the question as to whether the claims of such sonic differences can be substantiated by objective means, or whether it represents a form of misleading marketing or even mass delusion, perhaps perpetuated by the nostalgia of analogue hardware and its association with successful music artists, and the willingness of plugin manufacturers to affirm this association. On

the websites of the analogue modelling plugins used in this study, we see claims such as:

Think names like Queen, David Bowie, Nirvana, Red Hot Chili Peppers, Slipknot and more.

brehtaking depth, pristine high end and rich definition... [this plugin] brings the sound of this desk into the digital domain.

The sound of this analog legend is nothing short of extraordinary... you will find that same full-bodied aggressive power, to help make your records sound as analog as possible.

Add warmth, presence, cohesion, and low-end punch that only genuine tape can provide

“desert island” compressor that has lent its character and punch to some of the greatest recordings in history.

Harness the 1176’s entire electronic path including transformers and FET and transistor amplifiers for colorful distortion

This study addresses two key questions regarding these plugins:

1. Do analogue modelling plugins deliver the purported sonic qualities claimed by manufacturers in sufficient abundance to be audible in a mix, when consumed in a typical way?
2. If these qualities are audible, are they actually preferred by listeners?

2. Methods

2.1 Preparation of the two mixes

The multitrack of a neo-freakbeat song, composed, performed and recorded by the author in 2014, was mixed by the author using analogue modelling plugins to subjectively achieve a pleasant mix appropriate for the genre. The song was chosen for its mid 1960s influence, for which mid 1960s audio hardware emulations would be aesthetically fitting.

If analogue modelling plugins add a “vintage” sound, whatever that is taken to mean, we ought not start with a multitrack that could be considered *already vintage-sounding*. Genuine 1960s recordings are associated with frequency response and noise floor issues, limited track counts, and harmonic and

intermodulation distortion issues. Such additional variables could perceptually compete with, diminish, or otherwise serve to obfuscate, the sound characteristics of a mix with analogue modelling plugins, since part of their desirable sound qualities could be found in imitating these formerly prevalent technological challenges. As the song in this study was recorded using modern transparent audio equipment, we were able to have both an ascetically suitable medium for plugin models of 1960s hardware without the associated confounding artefacts.

The “analogue mix” consisted of the following plugins from widely regarded plugin manufacturers:

“Studer A800” type tape emulation

- 19 instances were used, one on every audio track

“1176” type compressor

- 9 instances were used for all compression needs

“Vintage Neve” type channel strip

- 21 instances were used, making extensive use of the EQ and filter sections, as well as adjusting all level with the built in fader rather than the fader of the DAW. There were two more instances used than there were audio tracks, as there were also sub groups / busses used in the mix.

After a satisfactory “analogue mix” was achieved, a new mix was made, attempting to replicate as closely as possible the equalisation and dynamic processing of the analogue mix. To help with this, two main tools were used, Bertom EQ Curve Analyser and the author’s own gain reduction analyser, CompView. Any place where the analogue modelling plugins had altered the frequency response, the cramping-type, aesthetically unimpressive, stock REAPER ReaEQ plugin was used to compensate. Any place the 1176 style plugin was used, the author’s own free open source compressor plugin, APComp (Continuously Variable Convexity Compressor), was used in place, with a combination of visual matching using CompView and manually matching by ear, due to the limitations of inspecting a compressor using only a test tone.

The tape saturation was not compensated for and any place where saturation could have been produced by the analogue modelling plugins, which

likely includes all 49 instances, was deliberately overlooked in this regard.

In addition to these plugins, one auxiliary reverb was used and one auxiliary delay as a slap back was used, and these settings were common and identical between both mixes. The only remaining plugin was a single instance of TDR Nova dynamic EQ which was used to compensate for some high frequency limiting that was occurring on the vocals which, when left uncompensated for, was quite apparent.

None of the instances of ReaEQ were particularly extravagant in their settings, the majority using only 1-3 bands of EQ.

It should be noted that the tape emulation plugin added a significant amount of unspecified EQ, approximately 4.5db at 55Hz and 1.6db at 9kHz. As a tape emulation plugin was used on every channel of the mix, one single ReaEQ was used on the master bus to compensate for this.

Both mixes feature a peak limiter to raise the level to a nominal loudness.

2.2 Participants

A total of 514 anonymous participants, recruited via a link in the description of the YouTube video, completed the survey, with 10 participants declining to answer the second question concerning their personal preference.

Listeners used their own playback devices to assess the mixes. As the video was published on a channel exclusively featuring discussions of audio engineering topics, and the video itself discussed the difficulty of discerning the two similar sounding mixes, it is a reasonable assumption that the majority of participants were aware of the need to listen critically.

2.3 Procedure

The YouTube video presented two mixes, clearly marked **A** and **B** using the *Tukan ABXNULL S2* plugin. The two mixes were switched between at regular intervals during continuous playback without interruption. This instantaneous switching, as opposed to fully auditioning each of the mixes in succession, was deemed by the author to make it easier for the participants to discern small differences between the two mixes. Alternatively, participants could download the uncompressed 24bit 44.1kHz audio which was also provided via a link in a pinned comment below the video.

The participants then selected which mix they had identified as being the analogue modelling mix and optionally which they subjectively preferred. The questions were stated as follows:

1. Which one was the analog modelling plugin mix?
2. Which one do you prefer?

2.4 Statistical Analysis

A binomial test was used to determine if the proportion of correct identifications differed significantly from what would be expected by chance. Alpha levels were set at 0.05 for all statistical tests.

3. Results

3.1 Identification of the "Analogue Mix"

Out of 514 responses to the identification question, 224 participants correctly identified the analogue modelling mix (43.6%). The null hypothesis (H_0) posited that participants would identify the analogue mix at chance levels (50%). The alternative hypothesis (H_1) proposed that participants would identify the analogue mix at a rate greater than chance.

To test this, the test statistic was calculated using a binomial test:

$$p = P(X \geq 257)$$

where X follows a binomial distribution with $n = 514$ and $p = 0.5$.

The resulting p-value was less than 0.004, indicating that the observed proportion of correct identifications was significantly different from chance. This leads to the rejection of the null hypothesis.

However, it is important to note that while the result was highly statistically significant, the majority of participants incorrectly identified mix **B** as the analogue mix, when it was actually mix **A**.

3.2 Preference for the "Analogue Mix"

For the second question, a similar analysis was performed with 10 fewer responses. Out of 504 participants, 246 preferred the analogue mix, which corresponds to 48.8%. The p-value for this test was

greater than 0.58, suggesting that there was no significant deviation from the null hypothesis. This indicates participants did not show a significant preference for the analogue mix.

4. Discussion

One plausible explanation for these results could be that, while listeners *could* hear a difference between the two mixes, whichever qualities they expected the analogue modelling plugins to impart, were actually more present in the digital mix, such that they mistakenly identified this mix instead. This character could even more plausibly been a *relative absence* of something undesirable. For instance, saturation modelling, often ostensibly considered desirable, could have in practice resulted in an additional level of processing which detracted slightly from the listener's appreciation of the music, when juxtaposed with the digital mix which lacked this additional processing.

The lack of statistical significance in the preference questions seems to indicate that, despite any perceived differences, none of these differences were reliably considered subjectively better or more pleasurable to listen to.

If this lack of preference is explained by subjective preferences varying widely among listeners, then it cannot be said that analogue modelling plugins are preferable when producing music for general consumption.

5. Limitations

5.1 Listening equipment and lossy audio

The study benefited from a reasonably large sample size with minimal barriers to participation by leveraging the popular video-sharing platform YouTube. One potential limitation to this approach would be the variability of playback devices and listening quality. It cannot be ruled out that some amount of participants judged the audio material listening on their smartphone speaker, or other playback device not typically associated with high quality audio reproduction. The variable of playback quality could be held constant by inviting the participants to a controlled environment with high quality headphones or a full range loudspeaker system in an acoustically treated room. Although true, such an objection may fail to engage with the goal of the inquiry. The study's relevance lies in its alignment with real-world listening conditions.

Paradoxically, a potential limitation is that the study participants may have experienced higher audio quality than is typical for the general population. This is due to the audio engineering focus of the host YouTube channel, which attracts many amateur and professional audio engineers. This elevated audio quality could have introduced a bias, potentially skewing the results towards a higher statistical significance than might be observed for the general population.

Given the significant prevalence of YouTube as a platform for music consumption, the quality of its audio is axiomatically sufficient for the purpose of this study.

5.2 Workflow

One argument for the use of analogue modelling plugins is that they provide a quicker, simpler workflow, as they often have fewer parameters and a predefined range of available sound qualities. In some sense, these plugins can be seen as “tweakable presets”, producing some subset of the possibilities obtainable with a full-featured non-modelling plugin of a comparable function. This is why, in creating the mixes for the study, it was necessary to first create the analogue mix and then match the digital mix to this, since the analogue-modelling plugins are largely incapable of any accurate matching when this direction is reversed. Yet it may be argued that this simplicity is more important to the mix engineer than any ostensibly coveted sound characteristics they may directly impart. Where the speed of use and preset-like nature cause the mix engineer to achieve a better sound as a result of an enhanced workflow. As such, this workflow theory could be posited as a study limitation: the *warm rich vintage tone*, or whichever description is considered appropriate by plugin manufacturers, was successfully achieved in virtue of these workflow influences; and subsequently matching the digital mix to the sound achieved in the analogue mix, fails to account for this difference in workflow.

Despite the enduring popularity of the workflow theory, it fails to offer substantive unifying power between the two aspects it seeks to explain, as there exists significant symmetry between the two plugin typologies in these areas:

- If the preset-like nature is essential, full featured non-modelling plugins typically have presets
- If set up speed is essential, modern DAWs such as REAPER are able to load a specific plugin

with a specific preset instantly with a single shortcut

- If simplistic interfaces are essential, some non-modelling plugins have “simple” and “advanced” view modes where the user can quickly shape the sound with only a few parameters while retaining control of the additional “advanced” parameters if needed
- If the visual aesthetics of the plugin are essential, many non-modelling plugins are also very aesthetically pleasing

In addition to these symmetries, there are asymmetries which serve to further undermine the theory:

- While limited parameter ranges do not entail quicker working times, limited parameter ranges may create friction causing prolonged working times
- While fully-featured, non-modelling plugins may include presets that can be altered instantaneously, the 'preset-like nature' of analog modelling plugins necessitates that the user remove the existing plugin instance and load a more suitable one if the desired sonic character cannot be achieved within the limited parameter ranges provided by the plugin

While the workflow theory may initially appear relevant to the methodology, given these observations which significantly undermine the theory, it does not seem to constitute a substantive limitation of the study design.

6. Conclusion

This study further calls into doubt the utility of using analogue modelling plugins in music production for general release and further raises questions of the cost-benefit kind, considering participants had no preference for the analogue modelling mix versus a mix with free non-modelling plugins.

The fact that participants incorrectly identified the analogue modelling mix with a high statistical significance raises the question of whether the bold marketing claims currently on the websites of many analogue modelling plugin manufacturers can be considered misleading to consumers.

7. References

AP Mastering (2024, July 24). *Analog Plugin Myth Debunked: 49 instances, no difference?* [Video]. YouTube. <https://www.youtube.com/watch?v=Iuo6r08GVDg>