



Searching for Sophia with Microphones

CHALLENGING MYTHS WITH RESEARCH

When it comes to sound recording, the choice of microphones used can greatly impact the outcome. There are numerous microphone options available, each with unique qualities and price ranges. Experts in sound engineering and recording have established specific preferences and practices to evaluate, which microphones and microphone types are most suitable for each different recording environment. Additionally, there is a wealth of knowledge and insight on the optimal placement and handling of microphones, thoroughly being documented in various manuals and handbooks dedicated to sound technology, sound recording and music production.

Text and pictures: *Jan-Olof Gullö*

In the music production domain, there are numerous notions and potential misconceptions regarding the requisites needed to create exceptional music. Even though these ideas may come from experienced producers and sound engineers, they need to be supported by evidence. Consequently, what may have begun as a well-informed observation can swiftly morph into a widely accepted myth.

However, the music production process can be complex, requiring careful attention to detail at every step. Each phase, from creating and/or capturing the source sound

unto the final mix, can have a significant impact on the overall quality of the listening experience. Typically, the source sound is being recorded in a room with a unique acoustic character, using a microphone mounted on a stand with a holder. This microphone generates an electrical signal that travels through cables and is being processed by advanced equipment such as microphone amplifiers. The sound is then being saved and processed in various analogue or digital formats before being played back through a speaker to a listener. Every aspect of this process is critical and

can influence the outcome, so it's essential to take great care and avoid any potential sources of error.

Our research group at the Royal College of Music in Stockholm, Sweden, has been studying music production under the umbrella of "Searching for Sophia in Music Production" for several years. Our main aim is to understand the factors that have contributed to the success of Swedish music exports in recent decades. The term Sophia refers to a classical Greek system of knowledge that serves as the theoretical framework for our project. Our team of

researchers examines both formal and informal learning processes related to music production in higher education, while other team members are dedicated to exploring various artistic elements. We also have a subproject focusing on the impact of myths and unfounded beliefs on students and professionals involved in music production activities in the absence of scientific studies or artistic research.

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The project "Searching for Sophia in Music Production" involves a sub-study focusing on microphones. Microphones are essential tools for recording music and audio, each one serving a particular purpose. Despite the advancements in microphone technology, some models from the mid-1900s are still in use today. This makes microphones different from other music recording equipment, and old vintage microphones are often highly valued. Nowadays, recording music has become accessible to more or less everyone owning a computer or mobile phone. Previously, recording required expensive and advanced equipment, but music recording software has made it possible to use expensive vintage equipment in cost-effective digital formats. These plug-ins have become widespread, making them more accessible. However, it can be challenging for music production students to differentiate between various technical equipment, particularly microphones. Our research project aims to clarify the differences and similarities between different microphone types. Our findings will benefit students in higher music education or anyone seeking guidance in choosing the appropriate microphone for their needs.

A series of sub-studies on the use of microphones in music production

Our research team has conducted several studies on using microphones in music production. We have already published some of those studies and have presented them at various conferences. We also plan to share more results from the project in forthcoming publications.

So far, the project has included sub-studies such as testing the intended use and approximate price of dynamic microphones, comparing professional high-quality microphones with a computer microphone

in vocal recordings, evaluating the use and listeners' understanding of different stereo microphone setups, testing unconventional microphone positions and also new ways of using microphones, using a mic robot to compare the dynamic, frequency, and directional responses of different brands and types of microphones. Here are some brief presentations of the studies conducted:

In a previous study, a group of music production bachelor students evaluated various dynamic microphones. The objective was to assess the microphones' intended use and approximate price. To ensure unbiased results, all microphones were covered with black PVC electrical insulation tape and had differently coloured windscreen foam covers. The study featured five handheld microphones with prices ranging from 25 to 400 €. During testing, participants used a portable SQN-4S mixer and a pair of Sony MDR-7506 headphones. Surprisingly, the results indicated that the participants could not differentiate between low-budget and expensive microphones. Although some individuals could describe differences between the microphones differently, all tested microphones were deemed suitable for most functions.

” The study results were enlightening, as most participants had difficulty distinguishing between the microphones when the recordings were processed with software and mixed.

Another previous study examined the quality of lead vocals' voice recordings captured by different microphones, including Neumann and AKG models, as well as the built-in microphone of an Apple computer. The participants were master and bachelor students in music production, teachers in higher education and sound engineers, who listened to the recordings, both solo and the completed mixed and mastered track. Their task was to identify the microphones used. The study results were enlightening, as most participants had difficulties distinguishing between the microphones when the recordings had been processed with software and mixed. While some listeners could correctly identify the microphones in unprocessed recordings, a significant number of participants made mistakes during the test and were surprised by the actual microphone used for each recording. Additionally, the study couldn't prove any significant



Robot for comparison of dynamic, frequency, and directional responses of different microphones

difference in the results between male and female voices.

As part of one of our studies, a group of bachelor students in a music production program were assigned to listen to studio recordings of an acoustic guitar and a mandolin. These recordings had been created using different microphone setups, such as XY-stereo, AB-stereo, and mid-side-stereo, using microphones like the Beyerdynamic M88TG, Sennheiser MD421-II, Shure SM58 LC and various Neumann models. The objective was to determine whether the recordings were in stereo or mono, and if in stereo, which specific stereo method was being used. As well we aimed to figure whether a dynamic or a condenser microphone had been used. While the listeners (in general) could distinguish between mono and stereo recordings, they found it quite challenging to identify the microphone setup itself. Many participants were surprised at the difficulty distinguishing between the various microphones during the listening process.

As a part of our ongoing studies, we are examining the microphone preferences of music producers in various recording scenarios. In our experimentation, we have explored both conventional and unconventional microphone placement methods. One of the unconventional method involves capturing the sound from the musician's perspective. We have utilized this approach to record several chamber music performances – including a contemporary piece

of music for trombone and piano – using a couple of high-quality condenser microphones. To achieve this, we set up our recording equipment the following way: a Pearl DS 70 4-channel, multi-pattern surround microphone was placed at a distance of 1.5 meters from the trombonist. This microphone has two dual-membrane capsules at 90 degrees with separate outputs, providing post-production flexibility regarding polar patterns and stereo setup. We also used a Pearl MS 8CL Mid-Side Stereo Microphone, positioned about 1.5 meters in front of the Steinway grand piano, and two Sony C-100 Dual-element microphones – set to omni in an AB-stereo configuration – positioned around a meter above the trombone player. Our recordings were made in an acoustically neutral chamber music hall, using a Focusrite Clarett 8Pre microphone pre-amp/audio interface. The recordings were stored digitally for post-processing. Upon review, we discovered that the unconventionally placed stereo pair with the Sony C-100 was particularly effective in creating a well-balanced mix.

As part of a sub-study, we conducted a test to record classical music and compared various XY stereo microphone setups. For the recording of classical piano music, we used different stereo pairs: Our primary microphone was the AKG Model C 426 B, a high-quality vintage microphone, that has two 25 mm gold-sputtered dual capsule sets arranged in a coincident pair. This microphone can be rotated to change the stereo recording modes and has been frequently used for classical music recording for the last few decades. We also used an XY stereo pair with the Shure SM-58, a popular dynamic mic for live-vocals known for its durability and sound quality. Although it remained an industry standard since the beginning of its production in 1966, it has seldom been used in stereo pairs for recording classical piano music. We also used a Zoom H4n, a digital recording device with two built-in XY cardioid microphones. For the final reference, we used the AKG C 426 B alone. However, during editing, we thoroughly examined the audio recorded with the other stereo pairs. The results from the Zoom H4n were surprisingly good, while the SM58s were usable but not preferred as a first choice.

We are also conducting a study that measures the dynamic, frequency, and directional responses of different brands and types of microphones. To achieve this, we play a series of audio excerpts – including noise, test tones and music – through a



Mic setup for piano recording

high-quality audio speaker in a music studio. We record the audio using one microphone at a time in different positions in front of the speaker. To ensure that all the microphones are positioned with the same distance from the audio speaker in different positions, we use a DynaMount mic robot. This robot allows us to remotely control and direct the microphone in different directions and distances from the sound source. By applying presets for different positions, we can compare the microphones repeatedly. We also test different microphones of the same type at identical positions and directions and at different audio levels. To compare differences, we use an A/B test by reversing one recording's polarity. This way we can identify the difference between two microphones. Surprisingly, when we performed this test on six brand-new Shure SM 57 microphones, we observed minimal differences. As part of this research project, we analyze software as well as microphones and software used in combination that claims to simulate the sound of different microphones. These systems record sound using either the manufacturer's microphones – such as those made by Slate and Antelope – or indicate in the interface – such as Lava by Acoustica –, which source microphone has been used. The objective is to form a sound by replicating the characteristics of a desired microphone to create the impression of this specific model being used at the other end. Although it may appear too good to be true, it is claimed to be possible using a cheap microphone-recording to create a simulated version with a sound of a classic, exclusive, vintage microphone. While such

software may not entirely reproduce the characteristics of classic microphones, such as their response, harmonic content, and proximity effect, it is still interesting to explore the software's impact on the audio files. Moreover, such systems may fulfil the dreams of many users wanting their microphones to sound like the ones they have dreamed of owning but do not have access to. Making this study even more fascinating is the fact that we (the Royal College of Music in Stockholm) have access to many of the microphones the software claims to simulate. This is an ongoing study, and the results we have obtained so far have been surprising in some cases but also, overall, could have been more exciting.

A few reflections

In addition to empirical studies as shown in the examples above, we also have investigated attitudes to and preferences for different microphones among music producers – both among professionals and students in education – through interviews and observations. One example is a study on how recording techniques are described in various manuals and handbooks of audio technology, sound recording, and music production.

During interviews with students and observations of their music recording practices, we identified a few aspects related to the use of microphones that need to be addressed: We have noticed that students tend to place the microphone very close to the sounding object, such as a singer, guitar amplifier or drum. When asked why doing so, they often respond by saying: „Isn't that the way you're

supposed to do it?" This indicates that they may have gained some knowledge from unreliable sources rather than consulting good handbooks on music production and audio recording. Furthermore, these results suggest that the students need to have more confidence in their ability to judge well. Handbooks on audio recording often provide guidelines on where to position the microphone in different recording situations. One common advice is that placing the microphone at the spot where it captures the sound you want would be the most crucial factor! For this reason, the person recording must rely on their senses and judgment to determine the ideal microphone position. In other words: It is essential to trust yourself and have good judgement when making these decisions.

We have also observed that students may have strong opinions about which microphone to use for different recording situations, e. g. when recording drums. When it comes to recording toms in a drum set, interviews and observations have indicated that many students prefer using Sennheiser MD421. However, it is unclear why

this is a common opinion among students. While we acknowledge that it may be a good choice, the question remains how and why students have formed this opinion. When analyzing handbooks and literature with anecdotal descriptions from successful recording sessions, it becomes evident that the position of the microphone and the acoustics of the room, among other factors, play a way more significant role in the quality of the recording. However, these aspects are often overlooked by the students we have interviewed. Therefore, research can be an effective tool to challenge widespread misconceptions and beliefs. We are excited to share some findings from our research, which we will be presenting at the tmt32 in Düsseldorf. We recognize that many individuals who are passionate about music and audio recording have strong opinions when it comes to audio quality, particularly regarding the use of microphones. This was precisely the motivation for our study. We are eager to engage in discussions with our fellow professionals at the tmt and delve deeper into this subject matter.



Jan-Olof Gullö is a Professor of Music Production at the Royal College of Music in Stockholm, Sweden. He has a professional background as a record producer and musician, specializing in double bass and electric bass. For many years, he has been actively involved in research for music production and teaching in higher education. Together with a team of scholars at the Royal College of Music, Gullö has conducted various studies on creativity in music production covering technical, entrepreneurial and artistic aspects.

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