A CRITICAL DATA CASE STUDY IN HUMAN-MACHINE CO-CREATION OF ELECTRO-ACOUSTIC MUSIC

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ABSTRACT

We present a critical data case study about human-machine interplay in the context of an electro-acoustic quartet performance. Based on a self-developed questionnaire, we conducted expert interviews with the four performing artists who also built and programmed the four instruments being played. The data being utilized by the instruments are a mix of self recorded and external sounds, with the latter often being of unclear provenance. Our results elucidate handling and documentation of data usage and show that encounters of legal and ethical concerns are often dominated by conscious artistic decisions, including data obfuscation or challenges to copyright conventions.

1. INTRODUCTION

This paper presents a critical data study in the context of the artistic interplay of humans and machines to co-create electro-acoustic music. More specifically we conducted four expert interviews with musicians concerning their data usage for instruments they created for a joint concert performance [1].

Critical data studies can be seen as a reaction to the "Big Data" paradigm encompassing very large data sets and the tools and procedures used to manipulate and analyze them [2]. In what is now already considered a classic text [3], it has been argued that it is necessary to critically interrogate the assumptions and biases of Big Data, and engage the resulting social, cultural, and ethical challenges [4]. The work presented here constitutes such a critical interrogation of data usage in human-machine music co-creation.

Although nowadays both commercial and artistic methods to automatically generate or at least co-create music rely on machine learning algorithms trained on large amounts of data [5], a critical reflection of the terms and circumstances of this data usage are rare. One point of critique of the commercial use of AI technology for creating and producing music is its grounding in neo-colonialist practices, where user data and existing music are used as a free and uncredited resource [6]. This connects to more general ethical considerations of AI applied to music, questioning the whole research ecosystem as well as which stakeholders exist and are benefiting to what degree [7]. In a stakeholder interview study with 43 musicians and related professionals, the interviewees voiced fears about work replacement, cultural homogenization and depletion of artistic agency [8] through usage of AI music tools. In an assessment of the openness of 16 music-generative AI models [9], it was documented that regarding data usage only a single model is fully transparent and only another single one provides a datasheet documenting data details. Also important are the legal aspects of copyright and training data [10], where distinctions between research and commercial use and a general reconciliation of creators, users, and technology developers have been advocated [11].

The most extensive study so far about the potentially exploitative nature of data collection practices specifically in automated music generation (AMG) research is by Morreale et al. [5]. The authors identified 121 papers published at ISMIR conferences [1] between 2013 and 2022 that fulfilled at least one of the two inclusion criteria: (i) presenting a new music generation model creating compositions or performances, (ii) reporting on datasets "that could potentially be utilized as training material for AMG models". Looking at the list of the 116 analyzed datasets [2] it seems clear that the focus is on various forms of classical and popular, but not experimental music. A key finding is that the majority of the datasets used or introduced in these papers were populated with existing music data, with about 40% scraped online and another 20% reusing existing data. Only about 15% involved musicians performing or arranging existing compositions or creating novel compositions. Only for 3 out of the 116 datasets explicit permission was sought from musicians to use their creations to train AMG models. Only 4 datasets included any ethical considerations or ethics statements in their descriptions. The authors conclude that in general human labor (writing, performing, transcribing, and recording music) is structurally obscured in AMG research and therefore formulate six suggestions for future work in the field:

- develop own datasets
- obtain consent from musicians and remunerate them
- document the process of dataset development
- report intended use of datasets
- maintain the original purpose of reused datasets

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[1] International Society for Music Information Retrieval Conference

[2] https://github.com/Sma1033/amgdatasetethics, assessed 18.6.2026

- volunteer ethical considerations

In addition, the authors suggest that future work should "conduct an ethnographic study with AMG dataset creators to give voice to their perspectives on the topic" [5].

In this paper we report such an ethnographic study concerning the usage of data in the more specific setting of four artists together co-creating electro-acoustic music with four machine learning or data based instruments of their own making. The concrete performance we investigated was the "Black Box Music" concert during the "Speculative Sound Synthesis Symposium" (September 2024, Graz, Austria) [1]. This concert was part of an arts-based research project about functional and affective relationships of humans and technological objects in the context of experimental music-making. [3] The four musicians participating in the concert beforehand each built or programmed one of the four instruments to be played during the performance. We deemed this concert a fruitful testbed to explore usage of data in human-machine co-creation of music since the four instruments use data in very different ways (see section 2). We conducted structured, qualitative expert interviews [12] (see section 3) with the four musicians using a questionnaire of 12 questions (see section 4) we derived from the six suggestions for responsible data usage by Morreale et al. [5] (see above). The research question we wanted to answer is:

> Which data were used, and what role did the data play in the instruments used during the "Black Box Music" concert at the "Speculative Sound Synthesis Symposium" (September 2024, Graz)?

Our research reported here goes beyond previous efforts [5] in two key aspects: it deals with machine learning and data based co-creation of electro-acoustic music instead of more commercially oriented musics; it directly engages with the artists using the data instead of analyzing dataset descriptions and respective literature.

2. INSTRUMENTS

The instruments we will describe now have been created for a musical performance as so-called "black box" music systems, where every instrument has been created/selected by one team member, but has been played by another team member, unaware of the inner workings. The complexity of electronic or algorithmic technologies used in contemporary music-making often exceeds the level of understanding by most artists in its full depth, resulting in an opaque black box nature which they pushed to the extreme by switching instruments between creators and performers. The four created instruments are vintage analog systems, physical modelling systems and AI-driven synthesis based on a sample corpus. A full-length video of the resulting quartet performance, which lasted ca. 24 minutes, is available. [4] The instruments are shown in figure 1 and the following descriptive quotes are taken from [1]:

"Angélica Castelló's music system (Instrument A) consists of a collection of old radios and cassette players, each in a different state of functionality. Their capricious behavior can range from accurately fulfilling their original purposes to producing completely unexpected sounds. This unpredictability invites us to embrace the quirks of the devices, transforming potential technical faults into new sonic opportunities and exploring the boundaries between controlled performance and random noise."

"Marco Döttlinger's instrument (B) uses machine learning and machine listening algorithms to navigate a corpus of audio samples. These are played by concatenative synthesis. The system listens to external audio input and – dependent on how the performer wants – it can be used functionally as a performance instrument but could also behave as an autonomous system without the need to interact."

"The apparatus built by Thomas Grill (Instrument C) is a spin-off from his "dirty spaces" series of works, in which he uses feedback processes that are disrupted with generative AI, among other things. The instrument is based on the RAVE algorithm (Caillon and Esling 2021), an auto-encoder for neural synthesis, and uses human language as a model corpus. It responds to both audio input and interactions with a MIDI controller. The model used was wheel.ts, a vocal model that is downloadable with the 'nn_tilde' package for the Max media programming environment. The unlabeled knobs of the controller modulate the latent space of the AI model in an undisclosed way."

"Finally, Patrik Lechner's instrument (D) consists of a custom digital simulation of FM radio transmission processes. Exploring novel sound possibilities and leaning towards the 'physical' radio aesthetic as well as connecting to bespoke mysticism sometimes found in analog sound transmission."



Figure 1. The four instruments by Castelló, Döttlinger, Grill and Lechner (from top left to bottom right).

[3] Spirits in Complexity: Making Kin with Experimental Music Systems (http://doi.org/10.55776/AR821)

[4] https://speculativesoundsynthesis.iem.sh/symposium/docs/proceedings/grill/, assessed 17.3.2026

3. INTERVIEW

The interview was conducted by the author of this article on the 23rd of February 2026 in the university seminar room where the bi-weekly project meetings are conducted. The interviews lasted 17 minutes (Castelló), 17 (Döttlinger), 11 (Grill), 14 (Lechner), and were undertaken without any disturbances or breaks. Since the interviewer and the interviewees have been acquainted for some years and worked together in a research project for the last two years, the interviews were conducted in a relaxed and trusting atmosphere. The interviews were done in German language, which is the mother tongue of all interview partners except Angélica Castelló, who has nevertheless a very good command of the language. For this article, all quotations have been translated to English by the interviewer. After a brief explanation about the context and aim of the interview all interviewees gave their informed consent concerning recording, archiving and publication of the interview. The twelve interview questions (Q1 to Q12, see next section 4) have been developed by the author of this article and are based on the suggestions by Morreale et al. [5] (see itemized list in section 1). We reformulated these suggestions as questions that are adapted to the more specific case of data usage during co-creation of electro-acoustic music.

4. RESULTS

At the beginning of each interview the interviewees were reminded that the questions concern the instruments used in the Black Box Music concert in September 2024 in Graz, Austria, and were also asked to briefly describe the instrument they built or programmed for this occasion.

Q1: Which data did you use for your instrument?

Castelló's instrument consisted of tape recorders playing recordings from an earlier joint performance with Thomas Grill which therefore contain both original sounds played by Grill plus whatever was playing in the other tape recorders at that time. In addition there were radios that were not fully functional delivering sound "more like static, distortion, things like that" but it could happen that there is "some music playing or a voice playing, that's there too".

Döttlinger was using recordings from one of his own previous compositions plus material from Castelló (sounds from only partly functional radios and tape recorders) and Lechner (simulated radio sounds).

Grill used a pre-trained audio synthesis model which has been part of a MaxMSP software package. He thinks it is a result of a research project at IRCAM, but cannot recall specifics and is aware that the download links is no longer functional. It is a model trained on human voices, probably only on female speech samples but details about the training data or parameters are unknown.

Lechner: The data Lechner used for the digital simulation of FM radio transmission processes was one of his own pieces, "a piece by Marco Döttlinger, and a Scientology advertisement that I [he] had downloaded from the internet". It lasts about five minutes and Lechner cannot recall where exactly he downloaded it from.

Summary: The four instruments use a wide variety of data including the artists' own previously recorded material as well as music and speech sources from radio, tapes and the internet.

Q2: Did you document the provenance of the data in the respective journal publication?

Castelló: The data has not been documented in the article.

Döttlinger: The data has not been documented in the article.

Grill: The download link for the data has been provided but is not functional anymore.

Lechner: The data has not been documented in the article.

Summary: The provenance of data is documented insufficiently in the accompanying publication.

Q3: Were musicians involved in any way in generating the data?

Castelló: The instrument plays back recordings from a previous performance together with Grill and random, often distorted, music and voices from radios.

Döttlinger: The musicians involved were Döttlinger himself, Castelló and Lechner, plus whatever artists were responsible for radio sounds recognizable in the data contributed by Castelló and Lechner.

Grill thinks that the model has been trained on real recorded voices, not on artificial ones. He does not know whether the voices were specifically recorded for the dataset or if these are "stolen data".

Lechner used recordings from his own and Döttlinger's work and in "this Scientology part, someone spoke. [...] but over elevator music".

Summary: The musicians involved are on the one hand the four artists themselves but also other essentially unknown groups of people that contributed to sounds from the radios, on the tapes and in sources from the internet.

Q4: Why did you (not) use your own data?

Castelló did use her own recordings of Grill's previous performance to surprise him and see "if Thomas could react to it [...] if he would recognize it". She uses radios because "I always use them because I still like working with that element of surprise, or chance" provided by both the distortions and recognizable music and voices.

Döttlinger explains that the concept to use each others sounds had been discussed at some point "but then the idea kind of got lost". The group "wanted to create something so that it wasn't completely arbitrary and super heterogeneous" and "that's why I [he] used the sounds from the others in my [his] instrument, so that it's kind of like a glue function".

Grill: It was an "artistic decision" to use data with unclear provenance since a certain opaqueness of the instru-

ment was essential for the black box concert. "It was actually tempting to take something where you have no idea how it was made. But finding out is also part of the exploration". Therefore it was "found suitable for the purpose" to utilize a pre-trained model without clear documentation.

Lechner states that "the idea behind this radio project is that the material is kind of provocative" and that he has "always found these religious aspects of radio projects interesting [...] this intersection of technology and faith". He also wanted to bring "a certain commercial element into radio" and "to create that contrast with this very commercial music" and his and Döttlinger's music.

Summary: The four instruments used a mix of own recorded sounds and sounds from a range of different external sources. The choice for this material was essentially dominated by artistic decisions.

Q5: Did you carefully document generation (or processing) of the data?

Castelló has not yet done this but "could document the process" of repeated adding to the content of the tapes as "a concept".

Döttlinger has not documented the data generation but does maintain folders with all audio tracks including provenance that are part of his instrument.

Grill: Processing of the voices was only done indirectly by manipulating the instrument's controlling knobs which modulate the latent space of the AI model. This can "strongly change the auditive appearance" from "real voices" to some kind of "babble". This process of latent space manipulation has not been documented.

Lechner has not documented the data generation but there is code which makes the process reproducible to a certain extent.

Summary: Generation and processing of data has not been documented in written form, only sometimes implicitly in terms of file folders and code.

Q6: Did you make the data publicly available?

Castelló has not made the content of her tapes available as she likes "making things disappear, and these tapes are meant to simply erase themselves or for someone to come and erase them".

Döttlinger has no intention to make the data public.

Grill: Did not create a data set hence the question does not apply.

Lechner says that his pieces are online.

Summary: Data has not been made available publicly.

Q7: Did you document what the intended use of the data is?

Summary: Since no data has been made publicly available the question does not apply.

Q8: Did you obtain permission of all people involved in generation of the data?

Castelló did "intentionally" not obtain permission because it is "an important part for me [her], taking things, appropriating them, and then giving them a new voice in my [her] artistic work", and she calls the result "sonic objet trouvé, kind of like Duchamp". In addition it would be very difficult to obtain permission since many radio sounds are "ephemeral" and "so distorted, you can't recognize it".

Döttlinger does have the consent of his colleagues to use their data but concerning material from other artists appearing in his colleague's data he "didn't look into it. Whether that's correct or how it works".

Grill did not obtain permission but states that "one almost has to assume that it [the data] is, to a certain extent, in the public domain" because of the way it has been distributed. At the same time he also wonders whether disappearance of the data from download services is because "there were problems after all and they withdrew it".

Lechner has the permission of Döttlinger and of course his own but "Scientology knows nothing about it".

Summary: Except for their immediate colleagues permission of other involved people was not obtained.

Q9: Does the use of data conform with the original intention when data was generated?

Castelló uses sounds irrespective of original intentions of their recordings "because I know [she knows] it [the sound] is so subtle that nobody will recognize it".

Döttlinger: Although his own sounds and those of his immediate colleagues have been composed for different contexts, Döttlinger sees no problem to re-purpose this data.

Grill does not recall whether any specific usage rights apply to the data.

Lechner thinks that data usage conforms to the original intention "only to a limited extent", e.g. he himself "didn't create the piece so that it would later be completely butchered".

Summary: It is often unclear whether data usage conforms with original intentions, also because these intentions are sometimes unknown.

Q10: Do you see a legal problem with using the data?

Castelló: Although many of the sounds Castelló uses are distorted beyond recognition, there are instances where "you can recognize the song immediately" including a "few Elvis bits I have here and there, or ABBA" and Castelló is aware that this could pose legal problems.

Döttlinger does not really see a legal problem because the data "are essentially synthesis material" and "nothing longer than a second or so is played consecutively" by his instrument, therefore the result is "very granulated", which renders the original sounds "not easily recognizable" and this is "also an artistic choice".

Grill: From the way the data was distributed Grill assumes that "hopefully the rights have been clarified".

Lechner thinks that there probably is a legal problem with the Scientology part with individual phrases being recognizable "if someone was familiar with it", but

"whether it was recognizable or not also depended on how well the signal was received in the simulated radio station. And it has never been played alone, never as a solo instrument in that sense".

Summary: The artists are aware that some of their usage of external sounds might pose legal problems, but these are maybe alleviated by distortions and other artistic strategies to obscure the materials.

Q11: Do you see an ethical problem with using the data?

Castelló does not "have an ethical problem with the superstars", but sees things differently e.g. in case of field recordings of "a child's voice" she has also used before. She thinks that "these superstars, somehow, already belong to me [her]" because "it's such a cultural phenomenon that also exploits me" and "also use me [her] as a listener" and "need me [her] to make all this richness".

Döttlinger thinks that "given that everyone is part of this quartet and that it's a collaborative artistic work, they haven't lost control over what happens with it". Therefore there should not be an ethical problem.

Grill states that one "can imagine all sorts of possibilities", for example that "the person who provided their voice recording might not have known that it would be used to create an AI model", but also that "if you were to cover yourself legally in every possible way, it wouldn't be so interesting anymore". Also he does not "always agree with the copyright law, as an artist, you do not have to comply with all exploitation rights one hundred percent, because that's more of an idea of the collecting society than the artist".

Lechner does not "feel like [he has] done anything wrong" and thinks that Scientology "wouldn't care" also because the work is not very critical about them.

Summary: In respect to ethical concerns answers vary given the different provenances of data. The interviewees see no ethical problems in using their immediate colleagues' data. In case of external data there usage is being justified either by supposed indifference of stakeholders involved or by conscious artistic decisions against copyright laws.

Q12: Do you discuss ethical aspects of data usage when reporting about your artistic work?

Castelló: For Castelló "in art, it's interesting when it remains mysterious and doesn't evoke too much", which allows to "confuse" people and if she "writes too much about it [...] that gets lost".

Döttlinger: For Döttlinger discussions of ethical aspects are "becoming increasingly important" to him. On the one hand he needs other artists' material e.g. for projects where "the model needs far too much data for me [him] to generate easily" or for "media art" approaches where the idea is to combine "something like German pop music and Death Metal and seeing what happens". On the other hand he specifically uses what he calls "small data", which is an "artistic decision and [...] part of the composition".

Grill: According to Grill, for the black box music concert ethical aspects are "the whole point" because "exploring, listening to unknown data or unknown instruments, that's what triggers these questions. It's definitely part of the discourse".

Lechner states that he "very, very rarely uses data" and that his music "is actually very strongly geared towards not using samples".

Summary: Concerning the discussion of ethical issues the interviewees are divided. One of them willingly does not engage in such discussion, to one of them the problem does not apply while for two others ethical topics are quite central to their work.

5. CONCLUSIONS

The point of departure for our case study reported here was previous research showing "a lack of adequate engagement with musicians and carelessness on ethical matters" [5] concerning data usage in the context of automated music generation (AMG), mainly for popular music.

Contrary to the results from this AMG study, which showed that a large majority of data had just been scraped from the internet, our case study on experimental human-machine music making had a more nuanced outcome: musicians did use their own previously recorded material, but also sources from radio, tapes and the internet. This latter material is often insufficiently documented with involved creators and owners of sounds often unknown and permissions not obtained. It is important to notice that the reason to include external material of more dubious provenance is often a conscious artistic decision. The musicians are well aware of legal problems this practice might entail, but think that these are often alleviated by artistic strategies to obscure the material. They do not have any substantial ethical concerns regarding the usage of external material in this performance, which again is motivated and argued with conscious artistic positions, e.g. questioning applicability of copyright laws.

Usage of their own recorded sounds of course is not burdened with these legal or ethical qualms and can be seen as a deliberate decision to use "small data" [13] in order to gain full artistic and legal control. The questions Q5, Q6 and Q7 concerning documentation and sharing of their own data did not really apply since the musicians basically do not make their data publicly available. These questions could therefore be omitted in future work employing our questionnaire.

Finally, an ethical turn in research on generative music AI has already been demanded and it has been proposed that corresponding issues should be discussed by the creators of technologies using music data themselves [6]. The musicians interviewed in this case study seemed more than willing to do this and see ethical considerations as central to their work. We are of course aware that the results reported here are only a limited case study but hope that they may serve as a blueprint for more extensive critical data studies in the field of human-machine music co-creation.

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