

“There is something thin about it.”

~ Daniel Dennett, philosopher, on AI-generated music by David Cope.

Motivations for using Artificial Intelligence in the
popular music composition and production process.

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Having started my master study in Applied Musicology at age 33 and attempting to finish it at age 35 has proven to be a challenge unlike any other. In January of 2019, I became a father. In February of 2019, I started my part-time internship at a VR-company, working three days a week as a teacher alongside it. In the middle of 2019, I started working on my thesis, spitballing first idea's and meeting with my supervisor Michiel. Aiming to stretch my writing process across the entire academic year, so that I could combine it with my newfound fatherhood and job seemed like a good idea, and it largely was. Until February of 2020, when the covid-19 pandemic suddenly locked most of my country down, and forced me to work, teach and study from home. I have eternal gratitude to my wife, who has had to take my stressfulness, ever-changing schedule and at times downright grumpiness in stride. She supported me in everything, took care of our daughter and kept our lives running while I stared at my laptop. An equal amount of gratitude goes out to my daughter, who's initial reaction to everything is to smile at it. You have motivated me to keep on going when I might not have been able to do so myself.

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Contents

Abstract	4
Introduction	5
AI – Opening the can of worms	
What is AI?	6
The missing methodology	9
Methodology	11
AI in music by Southern and Cope	12
Theoretical Framework	
Typology by Kivanc Tatar and Philippe Pasquier	14
Innovation: creative destruction or destructive creation?	16
Human and non-human agency	17
Analysis and Critical Discussion	
<i>I AM AI</i> by Taryn Southern	20
Juma applied to <i>I AM AI</i>	23
Agency and AI	26
AI and Creative Cognition	29
David Cope	30
Conclusion	34
Bibliography	37

Abstract

While there has been significant academic interest in AI-systems for musical composition, adoption of such systems by practitioners has been slow. Concurrently, Pearce, Meredith and Wiggins argue that research into AI is slowing because of a failure to develop and adopt an appropriate methodology.¹ PMW proffer a solution in through better categorisation, which Sven Deserno proves hasn't gained significant traction.² Issues surrounding artificial intelligence in music are further complicated by the ambiguous nature of the term, and it's widespread and often erroneous use in media. This thesis aims to answer questions surrounding this slow adoption of AI-systems for musical composition, the apparent hesitance towards embracing them for musically creative purposes, and practical aspects that might limit their use for composition of commercial music. It does so by juxtaposing Calestous Juma's theory on fear of adoption of new technologies,³ early historical and modern-day approaches to algorithmic thinking in music and creative thinking in music composition against experiences of makers and users of AI-systems for musical composition. I will focus specifically on the music of popular singer-songwriter and AI-enthusiast Taryn Southern and AI-researcher and composer David Cope and critical analysis of said systems. I argue that the slow adoption is caused by more than mere financial incentives, as many innovations have, but rather a specific type of fear of letting new technology invade the creative process that practitioners might identify as strictly human in nature, combined with the difficulty of effectively evaluating the usefulness of AI-systems, and a general lack of affordances regarding AI in musical composition. In 2000, David Cope mentions in his final chapter of *The Algorithmic Composer*: "what rational composer would refuse to listen to an algorithmic attempt to solve a problem".⁴ This thesis offers a beginning of an answer to Cope's hopeful or woeful prediction.

¹ Marcus Pearce, David Meredith, and Geraint Wiggins, "Motivations and Methodologies for Automation of the Compositional Process," *Musicae Scientiae* 6, no. 2 (September 2002): 119–47, <https://doi.org/10.1177/102986490200600203>.

² Sven Deserno, "Algorithmic Composition: An Overview of the Field, Inspired by a Criticism of Its Methods" (Aachen University, 2015), 5.

³ Calestous Juma, "Facing the Music," in *Innovation and Its Enemies: Why People Resist New Technologies* (Oxford University Press, 2016), 202–23, <https://doi.org/10.1093/acprof:oso/9780190467036.001.0001>.

⁴ David Cope, *The Algorithmic Composer*, The Computer Music and Digital Audio Series, v. 16 (Madison, Wis: A-R Ed, 2000), 260.

Introduction

In May of 2020, amidst the height of the Covid-19 pandemic, the AI-Songfestival was held in the Netherlands. Like the original Eurovision Songfestival (which was also to be held in the Netherlands in 2020), teams from European countries and Australia competed, this time with completely or partially AI-created music. Unlike the original, this Songfestival saw members not just from music professions, but from academia, interaction design and technology industries.⁵ Entries were judged on two criteria: human-AI-co-creativity and innovation. From the onset it is interesting to me that apparently, the judges found it important that AI-based creativity is combined with human creativity, and shall not stand on its own. Judge Vincent Koops states: “It’s not about how we can automate music, but about how we can be creative in new ways.”⁶ Initiator Karen van Dijk adds: “It can generate new ideas that we as humans perhaps could not think of.”⁷ This shows that in their eyes, AI has a role in generating new ideas, but less so in the more complex parts of music creation. I aim to find out what motivations popular music producers and composers have for using or not using AI technology.

Having earned my bachelor’s degree in Music Technology, and going on to become a producer for music in multimedia and a teacher in coding and sound design, I was never fully focussed on any individual aspect of music. My love for technology has led me to investigate the workings and usage of artificial intelligence (or AI), and my passion for music has sparked in interest in finding out how the two can be and currently are combined. Specifically, I am focusing on the usage of AI in the composition and production of popular music. The term AI is loaded with many different meanings and interpretations, not all relevant for this research. The specifics of this terminology will be looked at in the first chapter. The terms composition and production are often combined in this thesis, because in most popular music these processes are highly convoluted and it is often difficult to differentiate between compositional and productional aspects. For instance, is the choosing

⁵ “Het AI-panel over de AI Songfestival-inzendingen - Het AI Songfestival,” VPRO, accessed May 14, 2020, <https://www.vpro.nl/programmas/ai-songfestival/artikelen/ai-panel-over-de-inzendingen.html>.

⁶ “Het Songfestival dat wel doorgaat, komt uit een computer,” accessed May 14, 2020, <https://nos.nl/l/2333656>.

⁷ “Het Songfestival dat wel doorgaat, komt uit een computer.”

of a specific synthesizer sound (with implications for arrangement, harmony, range etcetera) a compositional or productional decision? In practice, the productional and compositional aspects are also usually combined, it is not uncommon for producers to get both writing and production credit. To steer clear of further discussions on such terminology, I will use the terms production and compositing where applicable, or simply refer to music creation in more general instances.

Both mainstream media coverage and academic interest in AI have grown significantly in recent years. AI is seeing adoption in many fields, from healthcare, administrative judgement and gaming, to political marketing, news filtering and graphic design.⁸ For many years, the decision-making processes in these fields were deemed best left to humans: a doctor diagnoses, a marketing manager decides on a strategy, and a graphic designer chooses the desired shape. AI has caused a change in this perception. Now, in some cases, algorithms are better at diagnosing than doctors.⁹ Designers do not draw but rather tell a system to draw for them, sometimes with highly beneficial financial consequences.¹⁰ It would seem logical that this trend would also continue into music composition and production. Having a fair grasp on modern music technology and music production trends, I initially observed an absence of AI in this field. The Advanced Audio + Applications Exchange even wrote in a 2019 conference session: “The term “artificial intelligence” feels very uncomfortable to most trained musicians. How does the “art” get into “artificial”?”¹¹

⁸ Alex Hern, “Cambridge Analytica Scandal ‘Highlights Need for AI Regulation,’” *The Guardian*, April 15, 2018, sec. Technology, <https://www.theguardian.com/technology/2018/apr/16/cambridge-analytica-scandal-highlights-need-for-ai-regulation>; Ron Schmelzer, “AI Making Waves In News And Journalism,” *Forbes*, accessed May 14, 2020, <https://www.forbes.com/sites/cognitiveworld/2019/08/23/ai-making-waves-in-news-and-journalism/>; Chris Baraniuk, “Computer Paints ‘New Rembrandt,’” *BBC News*, April 6, 2016, sec. Technology, <https://www.bbc.com/news/technology-35977315>.

⁹ Yiming Ding et al., “A Deep Learning Model to Predict a Diagnosis of Alzheimer Disease by Using 18 F-FDG PET of the Brain,” *Radiology* 290, no. 2 (February 2019): 456–64, <https://doi.org/10.1148/radiol.2018180958>.

¹⁰ “Is Artificial Intelligence Set to Become Art’s next Medium? | Christie’s,” accessed May 14, 2020, <https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx>.

¹¹ The A3E is a leading music tech thinktank, with an advisory board of prominent figures from leading music technology companies and organizations such as Yamaha, Waves, Google, Berklee and the MIDI Manufacturers Association.

Music technology company Waves, a large player in software for mixing and producing music on computers, is largely producing redesigns of older software that emulates analogue equipment, rather than embracing new technologies such as AI.¹² In situations where AI can clearly be observed, its function and workings vary wildly. This has piqued my interest and in researching this topic, I found out that aside from this perceived absence and unclarity, there is actually some use of AI that is not specifically promoted or even mentioned as such.¹³ From this arose my main research question: what are the reasonings and motivations for popular music composers and producers to use, or not use AI-technology in the compositional and music production process? Further dissecting this question leads to the questions for what purposes music makers do use AI-technology, and what specific technologies they use? To shed some light on this, I will perform two case studies, of work by Taryn Southern and David Cope. In researching this topic, it became clear to me that the motivations for and practical usage of AI for music composition and production is both a fascinating and a complicated subject—dare I say, a can of worms.

¹² A clear example is one of Waves' flagship products: software recreations of vintage Abbey Road studio equipment.

¹³ Popular pitch-correction software Autotune by Antares uses AI-technology, but does not directly promote it as AI-powered software.

AI - opening the can of worms

What is AI?

Computational creativity, algorithmic composition, generative art, machine learning, neural networks, artificial intelligence (AI). The choice for AI in music as a research area is as relevant as it is complex. All these terms are complicated, often interchangeably used and sometimes highly technical in nature. To explain them all and their relation to one another might take as much time and space as this entire thesis. However, to answer the main questions in this thesis, an exact definition of any of these terms is not needed. To get a fair grasp on the substance and relationships between the terminology, some understanding is needed. The academic field of computational creativity can be explained as “a multidisciplinary endeavour that is located at the intersection of the fields of artificial intelligence, cognitive psychology, philosophy, and the arts. The goal of computational creativity is to model, simulate or replicate creativity using a computer...”.¹⁴ It focusses on all types and forms of creativity. Generative art is the practice of creating art through computational algorithms (not always, but often using computers), and can be seen as a subfield of computational creativity. Artificial intelligence is an umbrella term for technologies that use computer algorithms that mimic human intelligence. As such, they can be seen as the core, or engine of a generative art system. Not solely applicable to the creation, or “generation” of said art, they can also be used to analyse, curate, modulate or otherwise alter existing material. Machine learning is a way of training an AI system to do certain things, for instance, learning what a dog looks like in order to find a dog in a given picture, or draw a picture of a dog etc. Likewise, using machine learning, a system could also be taught what a certain chord sounds like, or how a certain style of melody is often structured. Neural networks comprise one of the technologies often used within AI, which mimics the way human brains process information.

There are many more technologies often mentioned under the umbrella term artificial intelligence. Important to notice in this regard is that however big and still growing the field of AI is, the inner workings are almost always complex and they almost always mimic a

¹⁴ “Association for Computational Creativity,” accessed January 16, 2020, <https://computationalcreativity.net/home/about/computational-creativity/>.

form of human information processing (be it creative, or other). In attempting to research the use of AI in music composition and production, many initial hurdles can be observed. To begin with, terminology. Usage of the words Artificial Intelligence and AI is diffuse in both mainstream media and academic writing. Mainstream media have dubbed many things “AI” without citing the specific workings (such as the use of neural networks) or specifying what they have to do with anything artificial or intelligent. AI is also difficult. It is often very complex (AI developers are often in very high demand) and difficult to explain. In mainstream media AI is often portrayed as a sort of “black box” of which the workings are beyond the comprehension of mere mortals. In academia, AI is mentioned more correctly and in-depth, but writings are usually about a very specific part or type of AI, and for a very specific goal. AI can take many forms and examples of AI at the opposite ends of the spectrum are often very different in nature. This makes identification, classification and discussion of AI difficult and often diffuse. While there is ample academic research into AI, the vast majority of academic research into AI for musical purposes is of a very technical nature, and treats AI as a problem-solving system. The focus is often more on the theoretical potential of systems, rather than on real-world usage, which itself has seen very little academic interest.

The missing methodology

In a conference paper by Geraint Anthony Wiggins and George Papadopoulos from 1999, they write about the field of algorithmic composition (a subset of AI): “We cannot help not to notice a twofold lack of experimental methodology in many research reports in this area.”¹⁵ In 2002 Pearce, Meredith and Wiggins identify a failure to adopt an appropriate methodology in research on algorithmic compositions.¹⁶ In 2012 Anna Jordanous too found that “evaluation of computational creativity was not being performed in a systematic or rigorous manner” and that a methodology was missing.¹⁷ Subsequently, during the

¹⁵ George Papadopoulos and Geraint Wiggins, “AI Methods for Algorithmic Composition: A Survey, a Critical View and Future Prospects,” 1999, 9.

¹⁶ Deserno, “Algorithmic Composition: An Overview of the Field, Inspired by a Criticism of Its Methods.”

¹⁷ Anna Jordanous, “A Standardised Procedure for Evaluating Creative Systems: Computational Creativity Evaluation Based on What It Is to Be Creative,” *Cognitive Computation* 4, no. 3 (September 2012): 6, <https://doi.org/10.1007/s12559-012-9156-1>.

literature research for this thesis I have observed that many writings on AI systems for music creation not only are of a very technical nature, but the goals and evaluation of said systems were often vague, absent or largely irrelevant to practitioners. For instance, the goal of a given AI-system might be to generate a melody that adheres to the stylistic rules of a specific folk-music subgenre but the meaning, usefulness and motivation for such a goal remains unclear.¹⁸ Wiggins fittingly raises the question of how we can incorporate musical meaning into AI-systems and proposes that said systems explicitly refer to musical factors such as tension and closure, the context of the performance, and geometrical models of pitch space.¹⁹ The case studies should provide some insight into whether these factors are noticeable and in what way the lack of methodology has impacted real-world usage.

¹⁸ Bob L. Sturm et al., "Machine Learning Research That Matters for Music Creation: A Case Study," *Journal of New Music Research* 48, no. 1 (January 2019): 36–55, <https://doi.org/10.1080/09298215.2018.1515233>.

¹⁹ Papadopoulos and Wiggins, "AI Methods for Algorithmic Composition: A Survey, a Critical View and Future Prospects," 7.

Methodology

Discourse analysis is chosen as the main research method. Evgeniya Aleshinskaya distinguishes between three different forms of discourse analysis of popular music topics, namely:²⁰

1. The study of song lyrics
2. The description of discourse on or about music
3. The analysis of music as discourse

Since the focus of this thesis is not on the music itself, but rather the creative process behind it, mainly the second method will be used. The creative process of a popular music album made with AI-tools (as described through interviews and accords of the composers/producers), the writings of academic and composer David Cope and reviews and articles from relevant mainstream media outlets such as the Forbes and The Verge are used as sources.²¹ Arguments of various scholars are used as lenses through which these sources are viewed. Through this analysis, a comprehensive insight into the motivations and considerations can be established. The inclusion of academic viewpoints, as well as first-hand descriptions by practitioners and reactions from media outlets together provide a broad view on the subject.

²⁰ Evgeniya Aleshinskaya, "Key Components of Musical Discourse Analysis," *Research in Language* 11, no. 4 (December 1, 2013): 423–44, <https://doi.org/10.2478/rela-2013-0007>.

²¹ Micha Breakstone, "Three Ways Artificial Intelligence Can Drive Human Innovation," *Forbes Tech Council*, accessed January 9, 2020, <https://www.forbes.com/sites/forbestechcouncil/2019/03/06/three-ways-artificial-intelligence-can-drive-human-innovation/>; Dani Deahl, "How AI-Generated Music Is Changing the Way Hits Are Made," *The Verge*, August 31, 2018, <https://www.theverge.com/2018/8/31/17777008/artificial-intelligence-taryn-southern-amper-music>.

AI in music by Southern and Cope

To provide a compact but fair cross-section of AI-usage in music composition and production I discuss two case studies. Details on usage of, and motivations for using AI in music production amongst pop music producers is not readily available. Since I am looking for real-world examples, I am looking at musical work already completed, and analysing them not on their musical content, but on the way they were created. My focus is on works by David Cope and the album *I AM AI* by Taryn Southern.²² The following cases are good subjects because not only is there ample documentation of their creative processes available (through interviews, for example), both have written about their process, and mainstream reactions and/or reviews are also available. While not the core demographic to which my research question applies, the varying fields in which the subjects are active does provide valuable insight. Furthermore, both are active composers, performers and writers, allowing for ample research material.

Taryn Southern

Southern is a popular music singer-songwriter and self-proclaimed “technopologist” with a specific interest in new technology and more specifically AI. She is very active on social media and has a fairly large following, having previously gained mainstream media attention in the United States. In 2018, she produced and co-wrote an album called *I AM AI* with the goal of using as much AI as possible in the composition and production process. Her creation of this album is well documented in interviews, reviews and through her own digital outlets. Taryn is not a trained musician, nor does she have a deep technological knowledge of AI, and as such, she is a good example of a real-world user of music composition and production tools. I will analyse the album, the documentation of the creative process, and reactions from mainstream media outlets.

David Cope

A well-known researcher and creator of multiple music generation systems that use AI, David Cope is a good example of someone who both creates AI on a very deep technical

²² Taryn Southern, *I AM AI* (Independent, 2018).

level, and uses it to create music in various genres. His writings on AI in music creation are extensive, with *The Algorithmic Composer* adding significantly to the academic discourse on the subject.²³ While his music creation software alone provides enough material to research extensively, this thesis focusses on his experiences in using said systems, and the outside reactions to the music they produced.

²³ Cope, *The Algorithmic Composer*.

Theoretical Framework

Typology by Kivanç Tatar and Philippe Pasquier

To circumvent spiralling into a never-ending discussion of what AI is and is not, this thesis uses an abbreviated interpretation of AI for musical purposes by Kivanç Tatar and Philippe Pasquier.²⁴ Tatar and Pasquier provide a typology not just of the often complex “agent architectures”,²⁵ but also of the musical tasks, human interaction modalities, and ways of communication, amongst other things. Other typologies and categorizations often focus on the technical differences between AI systems, or on specific musical tasks. Such an approach is not really useful here, since it omits factors such human interaction and environment. Tatar and Pasquier instead treat AI as autonomous tools for what they call musical metacreation, or MuMa, as a subset of computational creativity. While there are other tools for MuMa not directly related to AI, I will focus on AI for the sake of brevity, clarity and its applicability to the research question.

²⁴ Kivanç Tatar and Philippe Pasquier, “Musical Agents: A Typology and State of the Art towards Musical Metacreation,” *Journal of New Music Research* 48, no. 1 (January 2019): 56–105, <https://doi.org/10.1080/09298215.2018.1511736>.

²⁵ Agent architectures refers to the systematic approach used in creating an AI-system. For instance, one approach is to compare material of different sources and classify their similarities. Such architectures generally have a simple underlying concept but their inner workings are often very complex.

Tatar and Pasquier provide a typology in nine dimensions, as shown in figure 1:

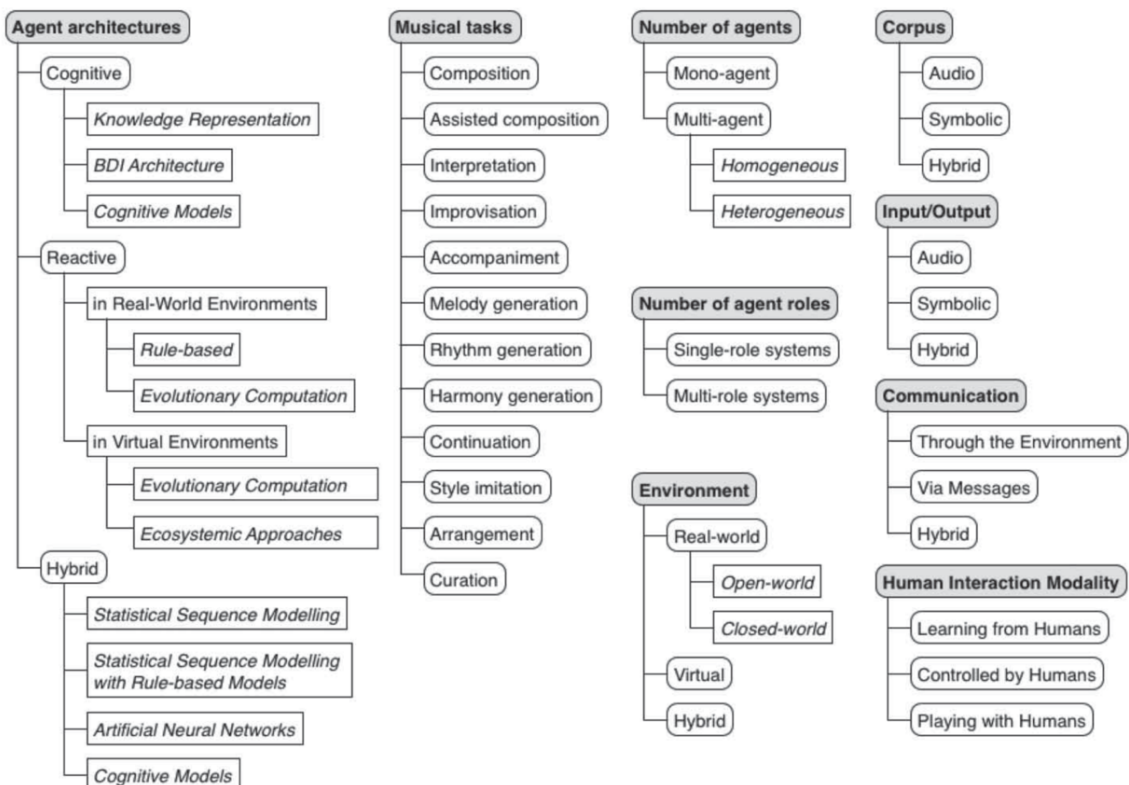


Figure 1: The nine dimensions of our musical agents typology.²⁶

This typology allows for focused analysis of AI systems and their usage because it emphasizes not only the nature of a given system, but also its method of communication, its environment and its interaction modality, which is often omitted in other research into AI for music. One can imagine the importance of how a particular system is controlled for its purpose as for instance, a melody generator. Since the focus of this thesis is on actual usage of AI systems, and motivation for their usage, not all of these classifications are equally applicable. Brevity and comprehensibility dictate that some of the classifications are omitted in this thesis. For instance, the different agent architectures, which are different technical approaches, are often hard to pinpoint, and may be irrelevant to the end user, because the complex nature of AI obfuscates the inner workings anyway. To better understand the AI systems used in the cases, I will attempt to classify them according to Tatar and Pasquier's typology.

²⁶ Tatar and Pasquier, "Musical Agents," 63.

Innovation: creative destruction or destructive creation? By Calestous Juma

In *Innovation and its Enemies*, Calestous Juma explains the impact of innovation (as diffuse a term as it is) on different sectors, amongst them the music industry.²⁷ While innovation bears many meanings, interpretations and definitions, major media outlets such as Forbes do describe AI as a highly innovative technology.²⁸ By reflection on the rise of music technologies such as early recording equipment in the 1940s, MP3-technology and file-sharing (amongst many other innovative technologies), Juma provides broad insight into the reactions to these innovative developments and their disruptive potential. Reactions from consumers, various stakeholders within the music industry as well as the creators of the technologies themselves are covered. Juma mentions a number of lessons that are to be learned from previous innovations in music technology:²⁹

1. While those invested in traditional technologies often fear a realistic loss of income or jobs because of innovative technologies, these technologies also create new economic opportunities, even in fields unrelated to music. A clear example is the ban on the recording of music in the United States in 1940, which was a reaction based on the fear of loss of jobs for performing musicians. The invention of recording equipment turned out to open up entirely new markets such as record stores, and eventually even sparked creations such as the iPod and Spotify. To sum up: technological innovations are incessant and as such defensive reactions to them are ultimately fruitless.
2. The invention of sound recording equipment sparked greater creative capabilities that could not be anticipated beforehand. In the end, we cannot predict the implications of innovative technologies on creativity by looking at the direct and immediate impact on those initially influenced.
3. Legal conflicts resulting from innovative technology will force us to re-evaluate intellectual property rights, as modes of creation and communication drastically change. A well-known example of this is the Napster-lawsuit,³⁰ in which copyright holders forced Napster to pay \$36 million in damages, but the “magic was out of the can” by that time, forcing a drastic change of strategy from copyright holders.³¹
4. “In many cases what appears as positive “creative destruction” to one group is viewed by another as “destructive creation” without obvious benefits to society. Managing such technological transitions therefore requires a better understanding of their nature, distribution, and welfare implications.”³²

²⁷ Juma, “Facing the Music.”

²⁸ Breakstone, “Three Ways Artificial Intelligence Can Drive Human Innovation.”

²⁹ Juma, “Facing the Music,” 220.

³⁰ *A&M Records, Inc. v. Napster, Inc.*, No. 239 F.3d 1004 (United States Court of Appeals for the Ninth Circuit February 12, 2001).

³¹ Juma, “Facing the Music,” 222.

³² Juma, 222.

I will analyse the case studies on these lessons, first to see if negative reactions to the cases indeed stem from parties invested in traditional technologies. Secondly, to see if AI has sparked unpredictable creative outcomes beyond their initial intended use. While legal conflicts may not be applicable to the chosen cases, it is worth analysing how intellectual property applies to them and how this has affected their real-world usage. Lastly, reasoning to use AI in the compositional and production process may stem from a stronger understanding of their nature, their distribution (including availability) and its welfare implications. It is of interest to analyse if these factors were strong influencers in the chosen cases.

Human and non-human agency

In *Art and Agency* Alfred Gell defines agency as “a point where the possibly infinite chain of causality is broken, and a “beginning” is attributed to a certain entity.”³³ Brabec de Mori goes on to argue that there are countless examples of non-human agency. The very term artificial intelligence immediately brings about questions of agency. If the usage of AI in the compositional process involves a matter of autonomy, is this non-human agency? If for instance a melody is generated by AI, but the parameters that the AI uses are controlled by a human, to whom can agency be attributed? It is impossible for us to trace causality down to a single point. Who is to say it is not the programmer of the AI, or even their choice of programming language, to whom (or which) agency should be attributed? We choose to attribute agency to some plausible and explainable beginning. The complex nature of AI further complicates this. It is however difficult to attribute intentionality to most non-human agents: “it seems that in order to be able to speak of music, sound must either be made into music by human mediators...”³⁴ Of the many different system architectures and approaches within AI some purely react to human input, while others have a form of spontaneous impulse generation, which one could argue makes the system’s choices intentional.

³³ Bernd Brabec de Mori, “Music and Non-Human Agency,” in *Ethnomusicology: A Contemporary Reader*, vol. 2, 11 (Routledge, 2017), 186.

³⁴ Brabec de Mori, 184.

In a 2018 paper Catarina Moruzzi argues that certain types of AI-systems named generative adversarial networks (GANs) can be both intentional and creative.³⁵ While the workings of GANs are too complex to explain in this thesis, Moruzzi mentions that “what is relevant is that GAN systems for music generation not only do not require the human presence if not for the initial input of data and rules, but they also bypass the issue of the limited creativity displayed by other software which is a result of mimicking the corpus of data given as input”.³⁶ It is worth noting that GANs are but one of many types of AI-systems, and most AI systems do require human presence and a direct means of control. Still, it is relevant to investigate whether the intentionality of non-human musical agents has any bearings on its real-world usage.

I will analyse the chosen cases to identify how Southern and Collins view agency, and to what they attribute it. Because both use AI in different ways and for different purposes, it is interesting to see how they view agency as it relates to their used AI systems, and how the differences amongst them relate to their motivations. This may help explain motivations for the uses and choice of specific AI systems for specific tasks as well. For instance, it seems more logical to attribute agency largely to oneself as a composer if AI is only used in curation and post-processing (mixing, choosing sounds, using virtual instruments) of human-composed material, but that may not be the case if the AI is also used for the generation of symbolic material. It is also interesting to note if mainstream media reactions to the cases attribute agency in the same way. An immediate example that this is not the case is the album *From Darkness, Light* by Emily Howell. Emily Howell is the name given to the AI system made by David Cope that fully generated the music on this album. Yet, large music outlets such as Spotify refuse to name Emily Howell as either composer or artist, instead naming Cope as both. Cope instead insists that Emily is the artist, and as a compromise, the album can be found on Spotify as *Emily Howell: From Darkness, Light* under

³⁵ Catarina Moruzzi, “Creative AI: Music Composition Programs as an Extension of the Composer’s Mind,” in *Philosophy and Theory of Artificial Intelligence 2017*, ed. Vincent C. Müller, vol. 44, *Studies in Applied Philosophy, Epistemology and Rational Ethics* (Cham: Springer International Publishing, 2018), 69–72, https://doi.org/10.1007/978-3-319-96448-5_8.

³⁶ Moruzzi, 2.

the artist David Cope. This is directly related to Juma's fourth lesson: intellectual property can by law not be attributed to a non-human or non-legal entity.

Analysis & Critical Discussion

Before I can begin to analyse the cases, we must settle not just on what constitutes AI, but also the differences between the often interchangeably used terminology of systems, tools, instruments, generators and other definitions. A commonality at least is that all used instances of AI technology are software. Caroline Cance's research on the linguistics of the term "musical instrument" teaches that in computer music literature and amongst members of the computer music community, these terms are used interchangeably, and in a broad sense mean the same thing.³⁷ A distinction can be made between "tool" as something that has a specific purpose, and "instrument" as something that provides a more broad creative possibility. In discussing AI software, the term "system" is also used, stemming from a more technological background. To avoid possibly endless discussion on these linguistics, I will attempt not to correctly name the given pieces of software, but rather use the terminology as it is provided either by their makers or as mentioned by the users in question. It is worth noting that the users in questions also use these terms interchangeably.

I AM AI - Taryn Southern

Southern's album *I AM AI* makes for an excellent case to study because not only is it highly applicable to the research question, there is ample context available in the form of Taryn's own online writings about the album, interviews, reviews, and audio sources. To begin analysis of her work, I will start with a list of questions and answers from interviews with press, compiled and supplied by Taryn herself.³⁸ Some of these interviews are of major media outlets such as Forbes, online tech-magazine The Verge, the BBC and Fox5. The first insight they provide is on the specifics AI-tools Taryn has used to make the album. In an interview by The Verge, she mentions having tried IBM's Watson software, Google's Magenta, and eventually finding Amper. In an interview with Cognilytica, she also

³⁷ Caroline Cance, "From Musical Instruments as Ontological Entities to Instrumental Quality: A Linguistic Exploration of Musical Instrumentality in the Digital Era," in *Musical Instruments in the 21st Century*, ed. Till Bovermann et al. (Singapore: Springer Singapore, 2017), 25–43, https://doi.org/10.1007/978-981-10-2951-6_3.

³⁸ Taryn Southern, "Common Questions about I AM AI (Press/Academic)," accessed January 31, 2020, https://docs.google.com/document/d/1mTelMocJD788hk_x4Ce-bwnPmVXoogVG5tezB9lSirQ/edit?usp=embed_facebook.

mentions using Aiva. I will continue with a short explanation of each four softwares and their possible uses, including a classification according to Tatar and Pasquier, and follow with a possible reasoning by Taryn for wanting to use these systems.

IBM Watson

Watson is a suite of AI-tools of which three seem to be applicable to music making, namely Tone Analyzer and Alchemy Language for generating lyrics and Watson Beat for expanding on musical data input by the user.³⁹ It is unclear which architecture they use, but simple explanations from the Watson website seem to indicate that the first two use a form of Cognitive Knowledge Representation, basing its output largely on an enormous amount of textual content from various sources. Watson Beat seems to use a Reactive architecture with a form of Evolutionary Computation, expanding on note input from the user.⁴⁰ The Musical Tasks of the lyrics generators can be seen as compositional or perhaps assisted compositional, as they seem to output rather autonomously. Watson Beat's Musical Task seems to be that of continuation, requiring human musical input and basing its output off of that. They seem mono-agent, Single role systems that interact through messages (computer code or scripts) and output text or symbolic music, most likely in the form of MIDI.

Google's Magenta

Magenta, like Watson, is also a suite of AI-tools, but all of Magenta's tools are geared towards music making. It is unclear which parts of the suite Taryn used or planned on using. Magenta is open-source, meaning its workings can be freely inspected, used and changed by users. As such, it's exact workings and architectures can be analysed, but this would require an immense amount of highly technical work. Magenta's main tool at the time of writing is Magenta Studio, a suite of tools providing multiple Musical Tasks. Descriptions on Magenta's website,⁴¹ and videos on the Magenta YouTube channel can help

³⁹ "Listen to 'Not Easy', the New Collaboration by AlexDaKid + IBM Watson. #CognitiveMusic," IBM Watson Music, April 6, 2016, <http://www.ibm.com/watson/music/uk-en>.

⁴⁰ Reactive systems apply logic to given input, generally MIDI notes, and attempt to continue a sequence. For instance, if one plays a major arpeggio, it would be logical for the system to continue this arpeggio in the same key, tempo and rhythm. Evolutionary computation focusses on how sequences evolve over time.

⁴¹ "Magenta Studio," Magenta, accessed February 6, 2020, <https://magenta.tensorflow.org/studio/>.

to categorize it.⁴² It seems to focus on melody, harmony and rhythm generation or continuation. Like Watson, most of its algorithms are based on datasets of existing material. Taryn mentions that it operating it requires knowledge of code, but at the time of writing Magenta Studio does have a user-friendly graphical user interface. It is very likely that when Taryn researched Magenta, it was not very user friendly, and presented itself much like Watson, communicating through code or scripts.

Amper

A quick comparison between the album and demos on the Amper website seems to reveal that most if not all musical material comes from Amper (aside from the vocals). Unlike Watson and Magenta, Amper uses a web interface, with a user-friendly interface. In most media coverage of the album Amper is clearly mentioned, and other software much less so. She mentions needing technical help from “engineers”, most notably in the realm of computer scripting and coding (which arguably is not something most audio engineers can help with) to get Watson and/or Magenta working. She also mentions that both Watson and Magenta do not have graphical user interfaces (which she mentions as not “front facing”). The musical tasks that Amper can be used for are manifold: it offers melodic, harmonic and rhythmic generation, style imitation, composition and arrangement. These all seem to be reasons for her to mainly use Amper. Amper uses proprietary algorithms, but since a large function of it is its ability to emulate a specific style, it likely uses a neural network that has been trained on datasets of symbolic music (most likely MIDI or scores) from different musical styles.

Aiva

Aiva seems to be a lot like Amper, using a web-based user-friendly interface, and being trained on datasets. Taryn mentions that Aiva is trained mostly on classical music (the website currently mentions many different styles but it is likely that this is a recent development). She mentions that her reasoning for using Aiva is based on the reactions she received on her initial single “Break Free”, which was released before the album was

⁴² *Magenta Studio: Drumify Plugin*, accessed February 6, 2020, <https://www.youtube.com/watch?v=eYUaYzfZUCo>.

finished, possibly before any other material was written. These reactions, although their sources remain unclear, seem to indicate that “Break Free” sounds like “generic pop”. Using Aiva’s classical composition style, she wanted to see if trying a completely different stylistic approach would yield less generic results.

Juma applied to *I AM AI*

I want to start by dissecting Southern’s words on her general motivation for creating the *I AM AI* album. A good starting point comes from her press-kit on the *I AM AI* album:

When I was on YouTube, I felt owned by an algorithm. It’s a really tough job to sustain [...] I found myself really interested in VR/AR, and YouTube awarded me a grant to make a few experimental VR pieces. That launched my interest in AI for musical composition...and the rest is history.⁴³

This indicates both an artistic interest and a commercial one. Not having a professional music background, a motivation for using AI lies in the problem-solving approach to making music. In an interview by The Verge, she states that apart from curiosity a motivation for using AI is to compensate for her self-proclaimed limited musical ability⁴⁴. She has stated in multiple interviews that she does not see herself as a professional musician, nor does she intend to spend considerable amounts of money on music production⁴⁵. Having started her professional career on YouTube, she is most likely not what Juma calls invested in traditional technology. Juma teaches us that a defensive stance against innovation is to be expected from those invested in traditional tech. This sentiment is clearly worded in a BBC article on Southern’s album: “Could it create a No.1 hit? And, if it could, does that mean Ed Sheeran might soon be out of a job, replaced by an algorithm, with Bruno Mars and Adele following him not long after?”⁴⁶ In the same article, experts such as Francois Pachet do not think so,⁴⁷ and Southern seems to agree: “I think AI music systems will just become one of the tools that are at our disposal along with many others. A piano is

⁴³ Southern, “Common Questions about I AM AI (Press/Academic),” 11.

⁴⁴ Deahl, “How AI-Generated Music Is Changing the Way Hits Are Made.”

⁴⁵ Deahl.

⁴⁶ Alex Marshall, “Is Music about to Have Its First AI No.1? - BBC Music,” BBC.co.uk, February 28, 2018, /music/articles/0c3dc8f7-4853-4379-b0d5-62175d33d557.

⁴⁷ Francois Pachet is currently director of Spotify Creator Technology Research Lab and has previously led the Sony Computer Science Laboratory in Paris.

a tool. I'm sure back in the day people were just as horrified about the piano."⁴⁸ This indicates that she does not expect AI to be the goose that lays her a golden egg, but rather can help her in her creative musical endeavors. Southern is actively seeking out the options AI can bring her. A clear example is when she mentions her trouble with MIDI. Most AI-software, including Watson and Magenta, output MIDI only, which Southern mentions is too complex for her to use. Amper and Aiva output mix-ready audio tracks, which is much more suitable to her level of music production. Not wanting to hire expensive music professionals for this project, the power of AI has in this case clearly benefitted her. This is a clear distinction from professional music composers and producers, to whom the usage of MIDI is generally an integral part of their workflow. The routing, controlling and programming of MIDI can be a laborious task, which Southern has circumvented by using AI. As such, the pieces of software mentioned by Southern are a direct threat to popular music producers, or at least a part of their work. This may indicate why it is difficult to find popular music producers that openly use, or discuss their usage of AI technology to aid them.

The second main reasoning for Southern is an artistic one, becoming apparent from her explanation of how she views the AI pieces of software of her choice. In an interview with *The Verge*, she discusses whether AI is a collaborator or a tool: "A tool is something we can wield and a collaborator is something we work with. So yes, I would say AI feels much more like a collaborator."⁴⁹ She is quick to add: "Collaborator and a tool, cause I can also still tell it what to do." What I find interesting here is that she apparently feels the need to point out that it is not just a collaborator, that she is the one telling it what to do, that in some way it would be worse if this collaborator had the same amount of autonomy as herself. She seems to indicate that she appreciates that artistic input that AI can give her, she is not willing to fully hand over artistic agency to it. In the second chapter I will discuss the issue of agency more in depth. But before I do that, there is one more glaring commercial issue surrounding AI technology used for music composition and production, and it is of a legal nature.

⁴⁸ Marshall, "Is Music about to Have Its First AI No.1?"

⁴⁹ Deahl, "How AI-Generated Music Is Changing the Way Hits Are Made."

Juma's issues concerning intellectual property rights are immediately applicable to *I AM AI*. If defining AI is akin to opening up a can of worms, then copyright issues are surely wormfood. Not only are legal quarrels easy to imagine in the context of AI-based compositions, discussions concerning agency also come into focus. At the time of writing, copyright can legally only be attributed to humans or other legal entities such as companies. An interesting point of debate can be found in the FAQ-section of Aiva's website. As an answer to the question "Who owns the copyright of the music created with AIVA?", it mentions:

If you are using our Free or Standard Plans, AIVA owns the copyright of the compositions you create; you are granted a perpetual, non-transferable and non-commercial license to use & modify the compositions. If you subscribe to the Pro Plan, copyright ownership is transferred to you, and you may use the compositions commercially in any way you want.⁵⁰

An End User License Agreement is accompanied. It is highly debatable if this will hold up in court. After all, if software such as AIVA is a tool, how can the creator of the tool hold any copyright over the works created with said tool? Surely Fender never thought of suing Jimi Hendrix over copyright? But a guitar is not an intelligent autonomously creating piece of software. No, AI is more like a synthesizer: the user sets parameters and the system creates patterns of sound with a potential for highly unique and unpredictable output. The user is then free to use the generated sound however he or she pleases. I do not think the 1980's would have had any pop-music at all had synthesizer builders been awarded ownership of the works produced with their products. Circling back to the research topic, it is not the actual copyright issues that interest me, but whether they have any bearing on the motivations for using AI for music composition or not. Southern clearly does not bother with these. She mentions that her album is co-written by AI, and as such she would retain at least partial copyright. In reaction to Southern's explanation for how she sees AI tools for music production, The Verge's interviewer replies that she has power over it, for now. If that is the case, copyright would clearly belong to Southern. It is worth mentioning that

⁵⁰ "Who Owns the Copyright of the Music Created with AIVA?" AIVA Helpdesk, accessed February 10, 2020, <https://aiva.crisp.help/en/article/who-owns-the-copyright-of-the-music-created-with-aiva-139mpug/>.

regardless of whether Southern attributes any musical agency to her “collaboratools”, practical conflicts on intellectual property are unlikely to arise as long as there is no direct financial incentive. For *I AM AI*, there seems to be little cause for concern. At this exact time, the most popular track of the album, “Break Free”, has a mere 163,956 listens on Spotify, likely bringing in no more than pennies of royalty payouts. On YouTube, it fairs better, having been viewed just over two million times. For this track, Amper is the only AI software she has used. While it is thinkable that an ownership dispute might one day arise from a work with such view counts (and accompanying ad-revenue), *I AM AI* acts more as a marketing opportunity for Amper.

Agency and AI

Tatar and Pasquier offer up a usable and explainable definition of AI technology as it is used for musical purposes: “Musical agents are artificial agents that tackle musical creative tasks, partially or completely.”⁵¹ These are further defined into nine dimensions. Very roughly speaking, these agents tackle musical tasks (such as melodic generation, or continuation) either as single-role tasks (they help only with a given task, and perform no other musical function), or as more complex multi-role and/or multi-agent systems, tackling multiple creative tasks at the same time (such as generating and arranging entire compositions). This distinction is important because it says something about a system’s alleged creativity: if a system only “helps” with a singular problem, for instance making a given melody fit a certain musical style, it is likely to be viewed as a tool, creating less friction with the creative agency of the human controlling said system. Southern refers to the AI software that she uses as either collaborators or tools. The distinction here is that as a collaborator, the software holds some agency, as it acts at least partially autonomous. She seems to be but partially at ease with the thought of the creative process beginning with AI. This becomes clear when zooming in on the composition and production process of *I AM AI*. In an interview with Forbes, Southern explains her approach to using AI:

I start with the music and then write lyrics that I feel fit the sonic mood. In terms of working with the music, it’s not like you just press a button and a beautiful song is created. There is a certain amount of binary decision making by the human - BPM, rhythm, key, mood, instrumentation - and then the AI generates possibilities. Of

⁵¹ Tatar and Pasquier, “Musical Agents,” 1.

those possibilities, you pick the ones you like and the dump the ones you don't. It's then up to me to arrange the pieces in to a song structure to fit the lyrics. The process of working with human collaborators is quite similar. It's different every single time, but it can be tricky to find the right partner who understands your vision and is reliable. But there is a magic to making music with other people. I'm not done with that.⁵²

There are several interesting perspectives in this quote. First of all, she states that she writes lyrics. Her reasoning for writing her own lyrics and not employing AI for that is unclear, but is consistent with her views on AI as a collaborator. It is unlikely that she chose not to use AI for this purpose out of necessity: IBM's Watson contains multiple tools for lyrics generation.

Similarly, the sonic mood she mentions also seems to be one of the aspects she doesn't employ AI for. Wiggins makes an interesting remark about this when discussing the future prospects of AI for composition:

The big disadvantage of most, if not all, the computational models (in varying degrees) is that the music that they produce is meaningless: the computers do not have feelings, moods or intentions, they do not try to describe something with their music as humans do. Most of human music is referential or descriptive. The reference can be something abstract like an emotion, or something more objective such as a picture or a landscape. How can we incorporate concepts such as musical meaning in systems?⁵³

This seems to be a given for Southern, she does not even mention looking to use AI as a source for mood or meaning. Subsequently, while Wiggins does advise that future AI systems should include factors such as tension and intension, I am unaware of any such systems in existence.

Southern continues with a description of how the AI systems in question are controlled, and what is done with the output. While Tatar & Pasquier offer multiple options for controlling and communicating with AI systems, she mentions only very basic control methods or major musical factors such as tempo and key (which she erroneously describes as binary). It is also at this point clear that the systems only produce partial pieces of music that still have

⁵² Breakstone, "Three Ways Artificial Intelligence Can Drive Human Innovation."

⁵³ Papadopoulos and Wiggins, "AI Methods for Algorithmic Composition: A Survey, a Critical View and Future Prospects," 6.

to be arranged. As Tatar & Pasquier explicitly mention arrangement as one of the possible functions of AI systems, this would have been an option given the right tools, yet she chooses not to pursue using AI for this purpose either. The interview with The Verge also provides us with video footage of the production process. In it the process of mixing and “comping” can clearly be observed.⁵⁴ While this is not done by Southern, but rather by a studio engineer, these processes are clearly not done by AI: all the tools recognisable in the video are industry standard audio plugins that emulate a traditional analogue workflow. The mixing process also provides clear AI opportunities: major mixing software company Izotope has in recent years released AI-powered “assistive audio technology” under the product name Neutron.⁵⁵ It is not unlikely that Southern is unaware of such technology (she mentions that her initial approach to finding AI tools consisted of searching online for articles about AI music), her mixing engineer must surely have known of such software. It is worth mentioning that while Izotope is a reputed major industry brand, its Neutron software is geared more towards hobby musicians and is not on par with mixing done by a professional engineer.

A final minor observation is made when critically listening to the vocals: a trained ear can distinguish the particular sound of AutoTune, in other words, pitch correction. This can in a sense be seen as an AI-tool as well, since AutoTune applies a rule-based process that relies on note information analysed from the user’s input.

AI and Creative Cognition

Putting the practices of mixing and vocal tuning aside, and limiting my analysis to the musical tasks as described by Tatar & Pasquier, we can conclude that Southern uses AI for the following:

- Rhythm generation
- Harmony generation
- Accompaniment
- Composition

⁵⁴ Comping is a popular music production technique where bits and pieces of individual recording takes, usually of the same musical phrase, are taken and arranged to achieve an esthetically pleasing end result.

⁵⁵ <https://www.izotope.com/en/learn/whats-new-in-neutron-3.html> The version 3 update notes indicate the use of AI.

- Arrangement
- Style imitation

These tasks sometimes overlap but overall, they provide a clear image of their intended use: as building blocks generated to specifications, that still have to be interpreted, pieced together, modified or otherwise cast into the shape of a chosen musical form. Southern does not use AI for the following tasks:

- Interpretation
- Improvisation
- Melody generation
- Continuation
- Curation

Apparent from this division is lack of usage for creative tasks of a higher cognitive level, such as specific interpretation and curation of musical material. Blanka Bogunovic provides us with theories on cognition in music composition. In her article *Creative Cognition in Composing Music* she broadly defines two general stages in the composition process: generation and exploration.⁵⁶ The generation stage consists of the initial spark of creativity, based amongst other things on knowledge and memory retrieval. In Southern's case, this stage is occupied by AI in most situations. The second exploratory stage consists of processes such as examination of ideas, transformation, organization etcetera.⁵⁷ Southern takes this exploratory stage upon herself for all musical material, and for melody and lyrics, also the generation stage. Notes and comments by Southern on an early version of "Break Free", hosting on her Soundcloud account describe her process.⁵⁸ She mentions first writing the melody, changing to a lower key, moving a bell-part to the bridge section, re-arranging drums to fit the first chorus, cutting parts of the generated material, rendering percussion at half tempo, changing out instruments for synthesizer sounds and choosing which part would become the chorus. She also mentions that the source material (presumably everything except for the melody) was "probably the 8th iteration" of pre-arranged material output from Amper.

⁵⁶ Blanka Bogunovic, "Creative Cognition in Composing Music," *International Journal of Music* 1, no. 53 (May 16, 2019).

⁵⁷ Bogunovic, 96.

⁵⁸ Taryn Southern, "Break Free - Early Export from Amper; Pre-Arrangement," accessed May 14, 2020, <https://soundcloud.com/tarynsouthern/break-free-pre-arranged-no-vocals-only-ai/s-MlqhD>.

Southern's hesitation to attribute full creative agency to the AI technology for tasks such as curation and song structure, her choice not to use AI for melody or lyrics generation, her lack of AI-usage in matters of mixing and her interview answers that insist that she asserts control over the tools all point towards a voluntaristic view. Southern steers clear of the idea that giving the AI creative power in both the generative and exploratory stages ultimately predetermine the music, and effectively side-lines her as a composer. *I AM AI* is *her* album, made in collaboration with AI for very specific tasks, and as such its ultimate goal is to redefine Southern as a technologist rather than a has-been YouTuber. While she may not have any particular fear of losing income to AI technology, she most certainly fears AI as claiming creative agency or even supremacy over her. At last, it is apparent that Southern uses AI technology to support her own ideas, her concept of an album made with AI, her lyrical content focusing on futuristic themes, her chosen format of an album, its album art that of the human and the digital fusing, with Southern at the frontier.

David Cope

David Cope takes a unique place amongst AI researchers and musicians alike. He is both a well-regarded composer, having written multiple acclaimed classical pieces as well as a researcher who is trying to unravel the very nature of musical composition, down to the most intricate patterns and processes. As a creator of various self-composing AI systems his work has been instrumental to the development of AI music creation as a field of practice and research alike. Juma's lessons can largely be applied to his work: Cope too has had to deal with scorn from those in some way invested in classical concert tradition, while his AI creations have pushed the boundaries of classical composition in ways initially unimaginable. His work focusses mostly on classical music but parallels can be drawn between Cope's work and that of popular music producers. While his initial dabblings in AI were prompted by financial incentives,⁵⁹ he is for the most part a researcher whose motives seem largely non-commercial.

⁵⁹ Cope has noted in interviews that during a commercial writing assignment his financial distress combined with writer's block made him turn to AI for score composition.

Christopher Steiner's book *Automate This, How Algorithms Came To Rule This World*, about the impact of various AI-based technologies, describes and quotes Cope on his experiences with AI systems, and public reactions to them. As Steiner describes Cope:

He argues that all prolific composers, from Bach to Mozart to Beethoven, dealt in commodities. They developed patterns, Cope says, that they based on music they had heard throughout their lifetimes. Bach was never creating something wholly new, says Cope, but simply building incrementally on those who came before him.⁶⁰

It is not hard to see the parallel with popular music here, the cyclical nature of popular music is a well discussed topic. That in itself is however not an incentive to strive for AI technology to generate comparable qualities in music. His initial success in these endeavors, marked by his first large contribution to the field of AI music systems, is Emmy. Emmy is an AI system that generates classical music in the styles of various classical composers: Bach and Mozart to name just two. Cope succeeded in making a system that could generate music that peers could not distinguish from human compositions or even from those of the master whose work it was inspired by. The criticism came quick, as Steiner writes:

Daniel Dennett, a philosopher and cognitive scientist at Tufts University, appreciated the marvel of Emmy, but still didn't think a machine could compete. "As wonderful as Cope's work is, there is something thin about it," he said. A composer built from software has no sense of the real world and therefore no idea how to express true feelings through music, Dennett reasoned.⁶¹

Furthermore, the absence of knowledge about the origins of Emmy's worked elicited praise:

But when Cope would play the same music for people and not inform them it had sprouted from the processor chip of a PC, the listeners would often revel in the sound and remark on how deeply the music touched them. [...] "I began to feel I was viewed as simply a programmer, somebody who downloaded files and put together databases rather than someone who was involved in creativity," Cope says.⁶²

I want to draw a parallel with the popular music producer here. Cope had a clear goal (to create music in a specific genre, reached it (through his AI software), and was either praised or scorned as a programmer. Both outcomes would not be an attractive proposition to a popular music producer. While there are many practical motivations for using AI, and many

⁶⁰ Christopher Steiner, *Automate This: How Algorithms Came to Rule Our World*, 2013, 176, <http://choicereviews.org/review/10.5860/CHOICE.50-3899>.

⁶¹ Steiner, 178.

⁶² Steiner, 179.

options as well, withholding knowledge about the usage of said AI technology might be more beneficial to the popular music producer. Notable however is Cope's dedication. Not only did he continue his search for AI musicianship despite negative reactions, he has spent many years creating AI systems, something most popular music producers would most likely not be willing or able to do.

Cope eventually made an AI system he calls Annie, with whom he has so far created one publication: *Comes the Fiery Night*, a book of a thousand haiku-poems of which a part is writing by Japanese Haiku master, and the remainder is made by Annie.⁶³ Cope will not reveal how much is made by AI or which parts. This makes the matter of agency a difficult and all the more interesting. While Cope may be very willing to attribute agency almost solely to Annie, the public is left in the happy middle, not having to judge AI and its creative contribution quite so heavily. Had the public not known about Annie's involvement at all, there might not have been any discussion, only positive effects as the quality of the could speak for itself. This is an interesting proposition for popular music producers: to employ AI technology for purposes they see fit (as Southern has done), or as completely autonomous composition systems, leaving room for the other aspects that define popular music as successful. After all, as Cope puts it:

Machines run on binary mathematics. Humans don't. [...] Trying to replicate the human brain using binary mathematics is a lot different than creating it with cells and DNA. These are wonderful algorithms, but we may never do that.⁶⁴

Of course, the proposition of using AI but not being open about it leaves us with a difficult to research subject. What is clear is that in the reactions to Cope's work, a lot of fear of loss of artistic or even human value is mentioned. Colleagues are known to refer to Cope as the Tin Man, after the heartless character from *Wizard of Oz*.⁶⁵ Steiner writes about Cope: "He thought people heard what they wanted to hear. If people knew they were listening to music composed by a set of computer algorithms, Cope found they wouldn't allow the music to affect them."⁶⁶ Although speculative, it seems logical that popular music producers

⁶³ D. H. Cope, *Comes the Fiery Night* (CreateSpace Independent Publishing Platform, 2011).

⁶⁴ Steiner, *Automate This*, 187.

⁶⁵ A biography on Cope is even called *Tinman: A Life Explored* (ISBNL: 978-0595505951).

⁶⁶ Steiner, *Automate This*, 178.

would not only want to receive work for their ability, they want to be praised for it. Using AI, and being open about it, may stand in their way and at the same time feel like cheating. Cope struggled with this, but ultimately reasons: “you don’t credit the shovel with digging the hole, you credit the digger”.⁶⁷ The context of AI-created music is infinitely more complex, and as such AI-music creation tools cannot be judged by themselves, since its worth is far less apparent than that of a shovel.

⁶⁷ Steiner, 174.

Conclusion

Technical innovations in AI have provided popular music composers and producers with powerful tools for music creation. Traditionally the majority of AI tools for music production and composition has had an academic purpose. Commercial application of the underlying technologies is however being explored more and more by both technology giants such as Google and IBM, as well as smaller independent companies such as Amper Music and AIVA. The status of such tools remains unclear: they are neither instruments, nor are they composers on their own. The terms “tool” and “system” also do not do justice, pointing to a more utilitarian function. This provides some issues for marketability and may be a reason why adoption by professionals is slow. Research into the real-world application of AI-based music composition and production software has stagnated, in part due to lack of a good methodology. Further research into effective evaluation methodologies, as well as in effective terminology usage could levy this problem. Bypassing terminology issues, what is clear is that by far most commercially available AI-music creation software is of a generative nature: it provides a starting point for creative material and leaves some further explorative work to the user. Tatar & Pasquier provide a comprehensive typology of possible functions of AI-systems. Applying this typology to the software used by Southern in the creation of her album *I AM AI*, we can conclude that by far most uses fall in the generative category; explorative steps such as arrangement and curation are left to the user. Even though software such as Amper and AIVA do provide full music tracks that seem to have already undergone a series of formative steps into complete pieces of music, they are either not very appealing to Southern or uncontrollable. Further research (and development) into AI for the exploratory stage of music creation is needed in order for AI to become more useful and widespread.

From interviews and descriptions of Southern’s compositional process it becomes clear that she views the AI-software that she uses as both collaborators and tools, which I have dubbed collaboratools. The distinction is in the level of control: the software provides novel ideas and starting points or reacts to given input, much like a collaborator, but provides full control over such material, and does not imply the creation of complete musical works. Indeed, this can be a good thing. Research has shown that the erroneous and sometimes

unpredictable nature of AI-based systems can create interesting and original material.⁶⁸ As such, they remain tools that apart from their generative nature have little autonomy. This view of said systems as collaboratools provides Southern with multiple benefits. First off, it negates the fear of loss of income as theorized by Juma, and shows that Southern is both aware and in control of new potential offered by them. They also provide a sense of usability, requiring less technical knowledge of music production than traditional music production software. This argument is less likely to be relevant to most professional pop-music producers as they will most likely not be in need of more usability. What could possibly be valuable to both Southern and other popular music producers is the availability of AI-tools for the explorative stage of music creation. Currently, there are two obstacles with this, the first possibly being an effect of the second. There is currently hardly any AI-based music creations software commercially available that I know of that provides robust and useful explorative functions such as comparing, combining, transforming and organizing music material. Secondly, this very aspect of music creation seems to be exactly what producers are wary of handing over to AI, as it touches on the human aspect of music making. Southern is both explicit about this when she points out that she controls the tools and chooses what to use them for, and implicit in her decisions not to use AI for important aspects of pop music such as melody and lyrics. She wishes to retain agency, and while she embraces AI, she is not willing to fully hand over creative power to it.

As a researcher, programmer and composer, David Cope is far less hesitant in attributing agency and letting AI do the work. His systems are self-build and aimed at producing complete pieces of music. While initially driven towards AI-systems out of financial reasoning, his goals have shifted more towards exploring and exposing the compositional powers of AI technology. His experiences with negative reactions to his systems (much more so than to the system's music) can teach us that while motivation for using AI might be admirable, the simple knowledge that the music is not created by a human can constitute a negative stance towards it. So much so even that the music itself "sounds" less human. This indicates an attribution of humanness to the music itself, rather than to the creator, as if the value of music is determined not by its quality but by its heritage. Cope may not feel the

⁶⁸ Sturm et al., "Machine Learning Research That Matters for Music Creation," 39.

intrinsic motivation to approach AI as a collaborator, parallels can still be drawn between Cope and Southern on this subject. His work *Comes the Fiery Night* is comprised of haikus by both human haiku masters and his own haiku-generating AI-system. While not a direct comparison, Southern's collaboratools approach is in fact similar in retaining its human appeal, yet utilizing the power of AI.

AI-based musical compositions also currently reside in a legal grey area, as their current status is mostly uncopyrightable, but developments on including AI-based creative works is being made.⁶⁹ Currently, this poses no realistic problem as legal issues on copyright tend not to surface until there is commercial reason for them. Juma shows us countless examples of how technological innovations have forced entire markets to drastically change, and legislation to be revised. In that regard, we can expect AI-based music production and composition software, assuming they are indeed innovative, to at one point disrupt traditional music production markets, as they are currently still based on traditional values of song writing and studio recording. Amper and AIVA are proof that such traditions need not be restricted to humans. Southern shows us that from a usability standpoint, such technologies are now readily available. She also notes that for professional results, she still feels the need to largely alter AI-generated material, leaving plenty potential for such software to improve. David Cope has shown us that more full-fledged AI-based music, albeit in more traditional forms such as arias and sonatas, is feasible, and its commercial success is perhaps more limited by public perception of the means of creation rather than by quality of the end product. Like the tradition of ghost-writing, it is logical that one day, sooner rather than later, without the public knowing AI may take over more and more roles in the pop music production industry currently occupied by humans. Who knows, maybe AI can create winning music for the actual Eurovision Songfestival too? Maybe then we can finally put it to rest.

⁶⁹ Karen Fullerton, "Artificial Intelligence and Music: Open Questions of Copyright Law Engineering Praxis," Knowledge for policy - European Commission, September 20, 2019, https://ec.europa.eu/knowledge4policy/publication/artificial-intelligence-music-open-questions-copyright-law-engineering-praxis_en.

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