Feedback Saxophone: Expanding the Microphonic Process in Post-Digital Research-Creation

by

Gregory Bruce

A thesis submitted in conformity with the requirements
for the degree of Doctor of Musical Arts

Faculty of Music
University of Toronto

Feedback Saxophone: Expanding the Microphonic Process in Post-Digital Research-Creation

Gregory Bruce

Doctor of Musical Arts

Faculty of Music
University of Toronto

2023

Abstract

The microphonic process is the term I use to encapsulate how microphones, loudspeakers, and related media are used to support, extend, and innovate musical practice. In this research-creation thesis, I contextualize, document, and analyze my own application of the microphonic process – feedback saxophone. My feedback saxophone system combines the unique characteristics of the tenor saxophone with the idiosyncrasies of various microphones and loudspeakers to produce and manipulate acoustic feedback. While there are examples of similar systems, there is no standardization and little documentation exists outside of audio recordings. Furthermore, my work employs feedback in a systematized fashion that challenges its conventional, indeterminate use in performance and composition.

To support this research-creation, I discuss the history of the microphonic process, examine contemporary "microphonic" practices, and use these findings to describe and analyze my own works. For the history of the microphonic process, I discuss how microphone amplification

changed popular vocal technique through the work of early-microphone singer Bing Crosby. I then discuss how microphonic instrumentaria were variously employed by avant-garde and popular artists using the examples of *Mikrophonie I* by Karlheinz Stockhausen, Hugh Davies' feedback work *Quintet*, and the guitar-feedback practice of Jimi Hendrix.

Following this discussion of instrumentaria, I establish the contemporary context in which my research-creation occurs by examining two present-day microphonic saxophonists, Colin Stetson and John Butcher. I use their distinct electroacoustic practices as a springboard to explain recent musical-technological trends: from the accelerating consumption of digital media in the new paradigm of sound, to the reactionary concepts of post-digitalism and the minimally augmented instrument. Lastly, I describe the creation of three concert etudes for my post-digital, minimally augmented feedback saxophone system, and critically examine the new works' processes of creation, musical materials, and aesthetics.

Acknowledgments

I would like to first thank my loving partner, Keely, without whom I would not be here in one piece. My parents and siblings have also been nothing but supportive of all my creative endeavours (and wild plans) – I love you dearly. I have been incredibly lucky to work with my advisory team: Wallace Halladay, Eliot Britton, and (most importantly) my supervisor, Aiyun Huang. Their distinct knowledge, guidance, and inspiration have all proven invaluable. Last, but not least, thank you to every one of my teachers and bandmates over the years. Without you all, I would not have the awareness, sensitivity, or moxie to write such a wide-ranging, "theory of everything," document.

This thesis draws on research supported by the Social Sciences and Humanities Research Council and the TaPIR Lab at the University of Toronto.

Table of Contents

List of Figures

Introduction

The German avant-garde composer Karlheinz Stockhausen (1928-2007) used the term *Mikrophonie* to name two of his seminal works, *Mikrophonie I* (1964) and *Mikrophonie II* (1965). Where *Mikroskopie* (the use of microscopes) reveals new phenomena to the naked eye, *Mikrophonie* (the use of microphones) can create new sonic experiences. According to Stockhausen at the time of publishing *Mikrophonie I*, "The microphone has, up to now, been treated as a lifeless, passive recording instrument for the purpose of obtaining a sound playback that is as faithful as possible."[1] Stockhausen later elaborated that the "microphonic process" transformed sounds through the microphone, electronic manipulation, and amplification.[2] Expanding the scope and significance of the term, I consider the microphonic process as encapsulating how microphones, loudspeakers, and related media are used to support, extend, and innovate musical practice. Taking this perspective, despite Stockhausen's claims of innovation in *Mikrophonie I*, the microphonic process has in fact been used independently by artists long before, and after, his work.

Beginning in the early 20th century, the microphonic process continues to be an innovating force in contemporary music – one example being my research-creation in "feedback saxophone." My feedback saxophone system combines the unique characteristics of the tenor saxophone with the idiosyncrasies of various microphones and loudspeakers to produce and manipulate acoustic feedback. This saxophone-controlled feedback can be used to form standard musical gestures, such as scales and triads, as well as a variety of contemporary sounds, such as multiphonics and quarter tones; all of which can be employed by themselves or in tandem with conventional saxophone playing. While there are examples of similar systems, there is no standardization and little documentation exists outside of audio recordings. Furthermore, employing feedback in a

---

[1] Karlheinz Stockhausen, *Mikrophonie I: für Tamtam, 2 Mikrophone, 2 Filter und Regler, Nr. 15, 1964: 6 Spieler* (London: Universal Edition, 1974), 9.

[2] Karlheinz Stockhausen and Robin Maconie, *Stockhausen on Music* (London & New York: Marion Boyars, 1989), 78.

predictable and systematized fashion challenges its conventional, indeterminate use in performance and composition.

As a novel approach to the microphonic process, feedback saxophone makes for an exciting creative practice but the legitimacy of creative work acting as research within the university is contested. In invoking ongoing debates surrounding the nature and purpose of research-creation, I begin in Chapter 1 by discussing the literature on artistic research and describing relevant methodologies, with particular focus on Sandeep Bhagwati's AGNI method[3] and Lyle Skains' practice-based-research method.[4] From this discussion, I develop the "problem-practice-exegesis" framework for carrying out thesis-integrated research-creation that adheres to rigorous academic standards while also systematically producing creative results. The remainder of the thesis fulfills this methodology through providing background research on the microphonic process, examining its contemporary use in saxophone performance, and finally critically analyzing the processes and products of my feedback saxophone practice.

The findings of my background research allow me to define the microphonic process in Chapter 2. Using Cathy van Eck's four categories of how microphones and loudspeakers are used as musical instruments,[5] I describe the phenomenon of the microphonic process and give contemporary examples to facilitate a general understanding. From this broad perspective, I use questions raised by van Eck herself – as well as assumptions made by Stockhausen – to examine early microphone singing. To accomplish this, I first describe the principles behind the most important pre-electrical music technology, the phonograph, as well as the dominant style of singing that accompanied it. Then, I discuss the invention and adoption of the microphone, amplifier, and loudspeaker, and explain how these devices were used by the true pioneers of the microphonic process, early microphone singers. Early microphone singing was exemplified by

---

[3] Sandeep Bhagwati, "Sounding the Climate we Live in: On Ways and Means of Artistic Research in Music and Sound," (Draft Paper) The AEC European Platform for Artistic Research in Music EPARM 2021, 18-21 March 2021, Online. (A)

[4] Lyle Skains, "Creative Practice as Research: Discourse on Methodology," *Media Practice and Education* 19, 1 (2018): 82-97.

[5] Cathy van Eck, *Between Air and Electricity*, (New York: Bloomsbury Academic, 2018).

the seminal "crooner" Bing Crosby (1903-1977), whose soft, conversational technique popularized the microphone and forever changed vocal performance. I describe how Crosby's success ultimately led his revolutionary singing style to be assimilated into popular vocal performance, following which I argue that the microphone's newfound ubiquity should not discourage its analysis as a musical instrument within the microphonic process – setting the stage for further critical discussion.

In Chapter 3, I continue with the results of my background research by discussing a range of microphonic instrumentaria, practices, and pieces using three examples. The first example is *Mikrophonie I* by Stockhausen, the theory behind which greatly influenced this research. Close examination of the various techniques and interactions within the piece reveals that Stockhausen's contribution to the microphonic process is obfuscated by an overt focus on the microphone, as well as a disregard for innovations made by popular artists. The next two examples divergently employ the phenomenon of acoustic feedback, an important function of the microphonic process and the catalyst of my feedback saxophone work. *Quintet* (1968), by British composer and instrument designer Hugh Davies (1943-2005), is a seminal "process" composition and one of the first works to employ indeterminate acoustic feedback. In contrast, by codifying the new technique of determinate "harmonic" guitar feedback, Jimi Hendrix (1942-1970) transformed popular electric guitar performance practice.

Having determined the background history of the microphonic process, I then establish the contemporary context in which my own research-creation occurs. In Chapter 4, I examine two present-day "microphonic" saxophonists and continue cross-genre analyses. The avant-pop of saxophonist Colin Stetson (b. 1975) and the freely improvised feedback saxophone of John Butcher (b. 1954) demonstrate how the microphonic process continues today. Despite being developed largely in the 21st century, their practices bear more resemblance to Davies and Hendrix than prevailing digital approaches. To explain this, I draw on Paul Théberge's theory that with the adoption of digital media, musical-technological practice shifted from a technique-centred "style" paradigm to a consumer-based "sound" paradigm.[6] Two responses to classical

---

[6] Paul Théberge, *Any Sound You Can Imagine: Making Music / Consuming Technology* (Hanover: Wesleyan University Press, 1997), 191.

music's own sound paradigm were "interactive" electroacoustic music and digitally augmented instruments. Augmented instruments emerging from this response, however, failed to meaningfully impact instrumental technique due to their complex, maximal enhancements. To reconcile the shortcomings of such instruments with the success of Stetson and Butcher, I propose the concept of the minimally augmented instrument. Minimally augmented instruments adhere to values of the style paradigm, but also post-digitalism – an approach which harnesses the idiosyncrasies and noise of physical, analogue, and digital media.

Chapter 5 concerns my post-digital research-creation in the microphonic process. Using the AGNI method, I describe the creation three works for my feedback saxophone system, *Stride*, *Doina*, and *Yen*. In critical reflection and analysis, I examine issues concerning the works' equipment, notation, and musical language. Most importantly, I explain how the works' simple construction facilitates their function as reflexive tools, research documents, and creative artefacts. As reflexive tools, they establish the grammar of my feedback saxophone practice, which, as a completely novel approach, necessarily employs basic material. In this sense, they resemble etudes and other systematic classical works. Through clearly documenting this research, the scores may also act as accessible resources for interested artists and scholars. Before concluding, I briefly discuss the possibilities for expanding this research with scientific collaboration, differing instrumentation, and new equipment. Through comparing my work with Butcher, Stetson, and other artists, I show how my findings contribute to electroacoustic and saxophone performance practice, post-digitalism and the style paradigm, and how these feedback saxophone works serve as a useful model for research-creation.

1 Creative Practice as Research: Theory and Methodology

The role that creative activity plays within academic institutions is contested,[7] and there is much debate on whether artistic acts may be considered research at all. The skepticism towards research-creation[8] comes from some academics and artists who believe that creative practice cannot meaningfully contribute to, and is stifled by, academic modes of inquiry. This chapter discusses the literature on research-creation by answering two fundamental questions: (1) "how is creative practice research?" and (2) "what methods are appropriate for carrying out creative practice as research?"

To answer the first question, I address the topic of research-creation in general, beginning by summarizing common arguments against creative practice as research and then, centring on the work of Henk Borgdorff and Sandeep Bhagwati, I discuss research-creation as a form of knowledge generation that can exist in parallel with conventional modes of scholarship. Following this, I examine various categories of music research set out by both Borgdorff and Lyle Skains. I subsequently illustrate these categories on a music research "compass" and discuss how it can be used to facilitate the understanding of, and comparison between, various academic projects that incorporate creative practice. To answer the second question, I examine the research-creation methodologies of Bhagwati and Skains, and combine them to construct my "problem-practice-exegesis" approach. I conclude the chapter by describing how my research is carried out using this methodology.

---

[7] This was apparent from the varied perspectives and energized discussions presented at events in 2021 such as EPARM and the X-Disciplinary Congress, the latter at which I presented some of this material.

[8] Research-creation, artistic research, and practice-based-research are all terms for research that integrates artists and art into its methods, processes, outcomes, and knowledge generation. While there are subtle ontological and epistemological differences between each of these terms, they are treated as equal here. I will be using the term research-creation, as that is the federally recognized term in my home country of Canada.

1.1 Categorizing Research-Creation

1.1.1 Research v. Creation

Henk Borgdorff's book *The Conflict of the Faculties,*[9] begins by describing Immanuel Kant's 1789 pamphlet of the same name,[10] in which the German philosopher argued against the tiered system of scholarly disciplines. In Kant's time, those studying at the "lower faculties," the natural sciences, humanities, and philosophy, could only be awarded master's degrees. Those studying at the "higher faculties," theology, law, and medicine, could be awarded doctorate degrees. Today, over two hundred years later, Kant's argument against a hierarchical system of research is being echoed in the debate around research-creation. Borgdorff is one of many authors who suggest that we are in need of a similar paradigmatic shift to elevate the contemporary lowest faculty – research-creation – to a level commensurate with other forms of research.[11] While there have been many positive developments in this regard, research-creation still has its detractors.

The resistance to research-creation comes from two camps: artists in and outside universities who believe that art suffers when it is subjected to the metrics of research, and academics who believe that creative practice cannot contribute to knowledge in a manner comparable to conventional research. This debate is summarized in John Croft's *Composition is not Research*[12] and Ian Pace's rebuttal, *Composition And Performance Can Be, And Often Have Been, Research.*[13] Croft suggests that carrying out musical composition as research is a category error and therefore not suitable as a form of scholarly investigation. Moreover, he believes that the

---

[9] Henk Borgdorff, *The Conflict of the Faculties Perspectives on Artistic Research and Academia* (Leiden, Netherlands: Leiden University Press, 2012).

[10] Immanuel Kant and Mary J. Gregor, *The Conflict of the Faculties = Der Streit Der Fakultäten* (New York: Abaris Books, 1979).

[11] Borgdorff, *Conflict of the Faculties,* 26.

[12] John Croft, "Composition is not Research," *Tempo* 69, no. 272 (2015): 6-11.

[13] Ian Pace, "Composition And Performance Can Be, And Often Have Been, Research," *Tempo* 70, no. 275 (2016): 60-70.

notion of composition as research is "inimical to genuine musical originality,"[14] in other words, that artistic practice cannot flourish within the scholarly confines of research questions and findings. Ian Pace, among others,[15] counters Croft's statements by arguing that composers and performers often ask a great deal of questions in the process of their creative practices, even when working alone, and that they apply answers to these questions in their creative output. Rather than stifling creative practice, discursive research can highlight artistic significance by "verbally articulat[ing] the questions, issues, aims and objectives, and stages of compositional [or performance] activity, to open a window onto the process and offer the potential of use to others."[16]

In concluding his article, Pace contests that the real issue is not whether creative practice counts as research, but rather how to ensure that the methods and results of research-creation contribute in an equivalent manner to other forms of scholarly investigation.[17] Doubting the scholarly equivalency of research-creation is the line of reasoning among the second camp of detractors.[18] To address this issue, many scholars have indicated the need to include research-creation in its own category of knowledge generation, in addition to the humanities and sciences, so that it may be more easily accepted as a body of research onto itself. From this perspective, research-creation does not need to contribute in equal ways to conventional research, but rather produce distinct and complementary knowledge.

---

[14] Croft, "Composition," 6.

[15] Such as Halina Dunin-Woyseth, "Some Notes on Mode 1 and Mode 2: Adversaries or Dialogue Partners?" in *The Routledge Companion to Artistic Research in the Arts*, ed. Michael Biggs and Henrik Karlsson (New York: Routledge, 2011), 64-81.

[16] Pace, "Composition and Performance," 67.

[17] Pace, "Composition and Performance," 69.

[18] This argument plays out in how music programs are administered. For example, despite research-creation being federally recognized by the Social Sciences and Humanities Research Council in Canada (SSHRC), institutions such as the University of Toronto have funding policies that diminish its viability at the graduate level.

1.1.2 A Third Pillar of Research

To address the argument of scholarly equivalency for research-creation, composer and scholar Sandeep Bhagwati defines the three major forms of scholarly knowledge generation as follows:

> a) Research that formulates and further develops conceptual models of the world, based on data and the histories of ideas. This research paradigm drives the natural sciences as well as large parts of the humanities (philosophy, history, sociology, linguistics, economics, etc.)
>
> b) Research that studies the interaction of such models with the "real world," based on application and demonstration. This research paradigm drives research in medicine, pharmacology, engineering, education, music therapy, business management, etc.
>
> Artistic Research [research-creation], then, obviously is neither of those – rather, it reveals itself as a third stream of knowledge production:
>
> c) Artistic Research [research-creation] researches the ways and means by which we build (and can build) models of the world. [19]

Defining a third category of knowledge has also been suggested by Borgdorff. According to him, such a distinction ensures that research-creation "embodies the promise of a distinctive path in a methodological sense that differentiates artistic research from the more mainstream academic research."[20] Considering research-creation as a discrete mode of investigation has its uses but it also must be defined beyond this. Canada's Social Sciences and Humanities Research Council defines research-creation as: "an approach to research that combines creative and academic research practices, and supports the development of knowledge and innovation through artistic expression, scholarly investigation, and experimentation. The creation process is situated within the research activity and produces critically informed work in a variety of media (art forms)."[21] Borgdorff provides a more detailed definition:

> (1) The investigation should be intended as research. Inadvertent

---

[19] Bhagwati, "Sounding," 6. (A)

[20] Borgdorff, *Conflict of the Faculties*, 39.

[21] "Definition of Terms," Social Sciences and Humanities Research Council, accessed June 15, 2021, https://www.sshrc-crsh.gc.ca/funding-financement/programs-programmes/definitions-eng.aspx#a3.

> (fortuitous) contributions to knowledge and understanding cannot be regarded as research results…(2) Research involves original contributions – that is, the work should not previously have been carried out by other people, and it should add new insights or knowledge to the existing corpus...(3) The aim is to enhance knowledge and understanding. Works of art contribute as a rule to the artistic universe. That universe encompasses not only the traditional aesthetic sectors; today it also includes areas in which our social, psychological, and moral life is set in motion in other ways – other performative, evocative, and non-discursive ways. We can hence speak of research in the arts only when the practice of art delivers an intended, original contribution to what we know and understand.[22]

Common threads among these definitions include new ways of engagement, innovation, experimentation, as well as contributions to knowledge and understanding. Borgdorff's mention of intention is notable when comparing his definition to other institutions'. Neither SSHRC nor the Association Européenne des Conservatoires (AEC), one of Europe's leading research-creation institutions, mention intent.[23] Despite this, Borgdorff is not alone, as Lyle Skains has also identified the need for intention in carrying out this style of research. Her article "Creative Practice as Research: Discourse on Methodology" is a straightforward resource on this topic. For her, the intention to carry out creative practice as research comes in the form of a clearly defined research question that "helps to determine the scope of the creative practice" and "provides a framework for examining the creative activity."[24]

1.2 Forms of Music Research

Beyond general definitions, it is also necessary to distinguish sub-disciplines to ensure that rigorous standards are developed within research-creation and that a diverse set of approaches is embraced by the scholarly community. Søren Kjørup argues that this plurality is imperative for the healthy growth of research-creation as a field and will help avoid gatekeeping from those

---

[22] Borgdorff, *Conflict of the Faculties*, 42.

[23] "Key Concepts for AEC Members Artistic Research An AEC Council 'White Paper,' 2015," The Association Européenne des Conservatoires, accessed February 5, 2021, https://www.aec-music.eu/userfiles/File/Key%20Concepts/White%20Paper%20AR%20-%20Key%20Concepts%20for%20AEC%20Members%20-%20EN.pdf.

[24] Skains, "Creative Practice as Research," 88.

who believe they have found the "one and only *real* artistic research."[25] Likewise, varied approaches will help avoid the potentially suffocating effects of applying scientific models to artistic practice – a cause for concern for some skeptics. To facilitate this pluralistic thinking, I discuss the categories of music research that Skains and Borgdorff use in their writing (fig. 1-1), grouped together based on the categories' similarities.

Figure 1-1: Forms of Research-Creation, as described by Skains and Borgdorff.[26]

Skains' first category is practice and research, wherein artists draw from their own creative practice to analyze and criticize others' work. This relationship could also be inverted to include research-informed practice, such as when musicological and historical research inform present day period performance. Borgdorff's research on the arts is somewhat less practitioner-focused, in that there is complete separation between the researcher and the object of research. Musicology is an example of this, as creative processes and products are studied but are not part of the results, which are communicated primarily in literary form.

---

[25] Søren Kjørup, "Pleading for Plurality: Artistic And Other Kinds Of Research," in *The Routledge Companion to Research in the Arts*, eds. Michael Biggs and Henrik Karlsson (New York: Routledge, 2011), 54.

[26] Borgdorff, *Conflict of the Faculties*, 37-39; Skains, "Creative Practice," 85-86.

Second, Skains discusses practice-as-research, perhaps the most controversial of approaches to research-creation, where the research is embodied in only the creative process and products with no accompanying critical exegesis. Unsurprisingly, this approach receives the most skepticism regarding to its suitability in academia. Without communicating a clear methodology or discursive results, it is difficult to distinguish practice-as-research from any other creative activity. To paraphrase Bhagwati, if all practice is research, then none of it is research.[27] Borgdorff does not include such a category, as he suggests that researchers must contextualize the processes and products of their work to broader scholarly audiences.[28]

Next, Skains herself admits that the distinction between practice-led-research and other forms of practice-related research can be murky. She says that practice-led research "focuses on the nature of creative practice, leading to new knowledge of operational significance for that practice, in order to advance knowledge about or within practice. The results…may be communicated in a critical exegesis without inclusion of the creative artefact, though the creative practice is an integral part of the research."[29] A book of extended instrumental techniques is a possible example here – creative practice is at the heart of the research, while the final product is a book describing best practices, perhaps with images and audio files used for demonstration, but no explicitly creative product (such as a performance or composition) is necessary to communicate the results. This category bears close resemblance to research for the arts that, according to Borgdorff, "delivers…the tools and the knowledge of materials that are needed during the creative process or in the artistic product."[30]

Lastly, Skains suggests that in practice-based-research, the creative artefact itself contributes to knowledge and is accompanied by critical discussion that contextualizes and demonstrates the significance of the research. Full understanding of the research may only be achieved through

---

[27] Bhagwati made this comment on several occasions online: at EPARM March 2021 and at a talk he gave for the TaPIR Lab at the University of Toronto, June 2021.

[28] Borgdorff, *Conflict of the Faculties,* 25.

[29] Skains, "Creative Practice," 86.

[30] Borgdorff, *Conflict of the Faculties,* 38.

these elements working in tandem.[31] Borgdorff's definition of research in the arts aligns with Skains' category in that it assumes no separation between subject and object, nor between the researcher and their practice.[32] This is an inherently reflexive approach and seeks to communicate the knowledge embodied in artistic work.

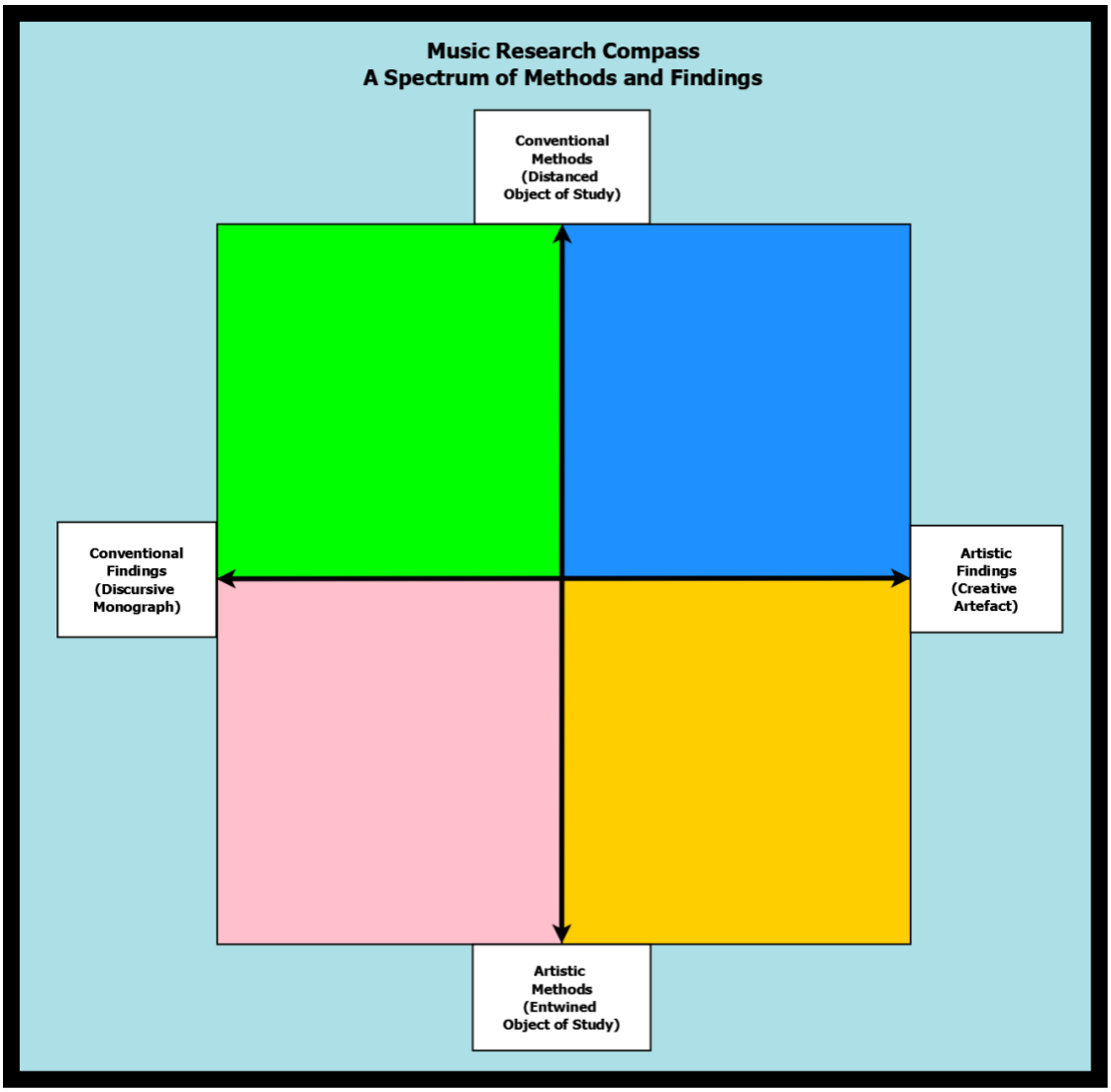


Figure 1-2: Music Research Compass.

While it is possible to imagine examples of research that would fall under each of these

[31] Skains, "Creative Practice," 86.

[32] Borgdorff, *Conflict of the Faculties*, 38.

categories, academics and artists from different disciplines will undoubtedly categorize examples in divergent ways. This became clear during a workshop[33] I gave on research-creation: without consensus on which projects fit what approach, the categories failed to provide much clarity. Consequently, I determined that these categories are, in practice, fluid examples on a spectrum of music research approaches. I have illustrated this spectrum on a "music research compass," with conventional findings and methods on the top left and artistic knowledge generation and methods on the bottom right (fig. 1-2). This compass highlights the role that creative practice plays in the research, whether in the methodology, the results, or both. Using this diagram can facilitate comparisons between research-creation projects, as well as between research-creation and conventional research. For instance, it would be challenging to evaluate a practice-as-research project alongside a practice-led-research project if their methods and results incorporate creative practice in widely differing ways. Conversely, identifying projects that are similarly situated on the graph invites comparison.

The x-axis represents the type of findings generated, from conventional findings presented in a discursive monograph on the far left, to artistic findings presented in the form of a creative artefact(s) on the far right. The y-axis represents the methods employed: on the top, conventional methods whereby the researcher is studying something completely outside of themselves (distanced object), on the bottom, artistic methods whereby the researcher uses their own creative practice as a mode of inquiry (entwined object). While figure 1-3 shows the same chart with examples within music research, it could be used for examining any field that included practice-based research. The circles represent the categories of research-creation I just discussed and are placed according to how artistic practice is employed within each one. In the top left corner, there is research on music, where the artistic practice of the researcher plays no role in the study, such as in music history. At the bottom right there is practice-as-research, where creative practice and research are one in the same. Neither the placement of the forms of research-creation, nor the examples given for each, are meant to be immovable. For example, music pedagogy research could find a home in numerous spaces on this chart, depending on the centrality of the researcher's artistic practice. Yet, the current discourse suggests that as music

[33] Online workshop for the TaPIR Lab at the University of Toronto. Oct 3, 2020.

research moves from the top left to the bottom right, that is as it becomes more fully art without any accompanying critical writing, it runs the risk of being labeled unscholarly. The convergent category of practice-based-research/research in the arts is perhaps the most suitable model of research-creation for graduate music programs requiring a thesis.

Figure 1-3: Music Research Compass with examples.

Where does my feedback saxophone research fit on this compass? As this multi-media thesis combines creative artefacts, scores, and recordings, along with discursive writing meant to analyze and contextualize, it can be categorized as practice-based-research/research in the arts. Being placed in the centre of the music research compass indicates that there is a balance

between conventional and practice-based findings, as well as methods. Situating the practice within a scholarly framework is the first step towards meaningful research-creation. Borrowing from the definitions I explored earlier, this practice must also produce critically informed works that make original contributions. The proceeding section on methodology demonstrates how this objective is realized.

1.3 Methodology

In this section, I answer the question, "What methods are appropriate for carrying out creative practice within a research context?" Using the answer, I build a methodology that ensures my findings are critically informed and meaningfully contribute to artistic and scholarly knowledge. As a relatively new research paradigm with a myriad of approaches, developing a methodology for a research-creation project has its difficulties. Without recognized standards, artist-researchers often devise their own methodology to fit their project, rather than beginning with a methodology to follow using their practice. Perhaps this is related to the reflexive nature of some forms of research-creation, but it nonetheless is challenging to find applicable methodological models. This problem is compounded when artists do research in a niche area, as I am, meaning there are fewer established methods, sources, and practices to draw on.

To address the dearth of methodologies, I have found two models that can be employed in a broad range of research-creation projects: Bhagwati's AGNI methodology and Skains' practice-based research method. The primary feature of AGNI (fig. 1-4) is its focus on iteration. Many of the authors cited here have commented on the reflexive nature of research-creation. As artists pursue research on, in, and through their crafts, new insights and new questions regarding their research topic are often revealed. Bhagwati addresses this reflexive nature by suggesting that iteration is not only a primary facet of research-creation but also a fundamental part of scientific inquiry. "[I]f we accept iterative methodology as the fundamental gesture of research, the details, rationales, supporting methodologies and artistic approaches employed during such a process can be extremely varied and, most importantly, come from different intellectual and epistemological traditions – and yet can all be validated through the same iterative gesture."[34]

---

[34] Bhagwati, "Sounding," 10. (A)

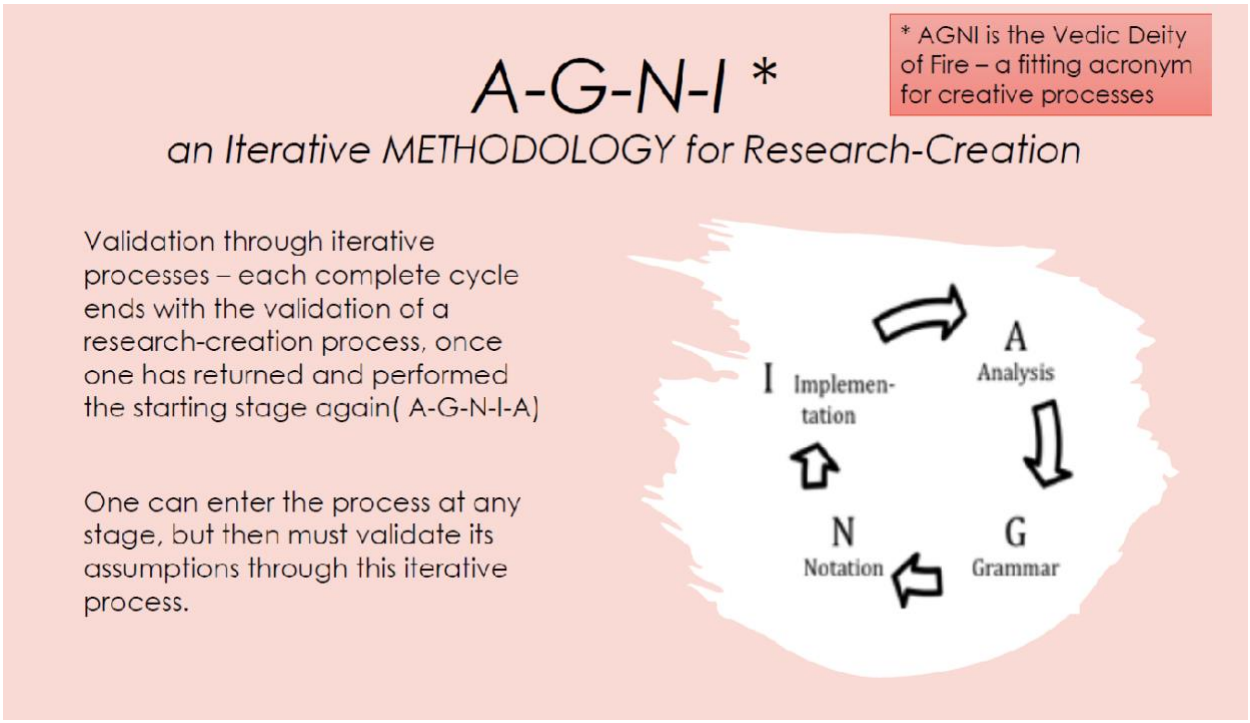


Figure 1-4: Bhagwati's AGNI Methodology.[35]

Skains' practice-based research method (fig. 1-5) is ideal for integrating creative practice with discursive writing. Her approach to research-creation incorporates iteration and ultimately ends in exegesis. Her methodology leads with a question or problem, which is in line with Borgdorff's definition of research in the arts, and is followed by background research on the topic. The iterative, cyclical process occurs in the middle, whereby the researcher updates their question/problem as contextual and empirical (practice-based) research is carried out. While Bhagwati's model may be more broadly applicable, Skains' approach is compatible with graduate programs that require a thesis to accompany creative activity. To take advantage of both approaches, I have combined these methodologies to create a model for the thesis-centred research-creation that I am engaged in, the "problem-practice-exegesis" methodology (fig. 1-6).

[35] Sandeep Bhagwati, "Sounding the Climate we Live in: On Ways and Means of Artistic Research in Music and Sound," (Power Point Slides) The AEC European Platform for Artistic Research in Music EPARM 2021, 18-21 March 2021, Online. (B)

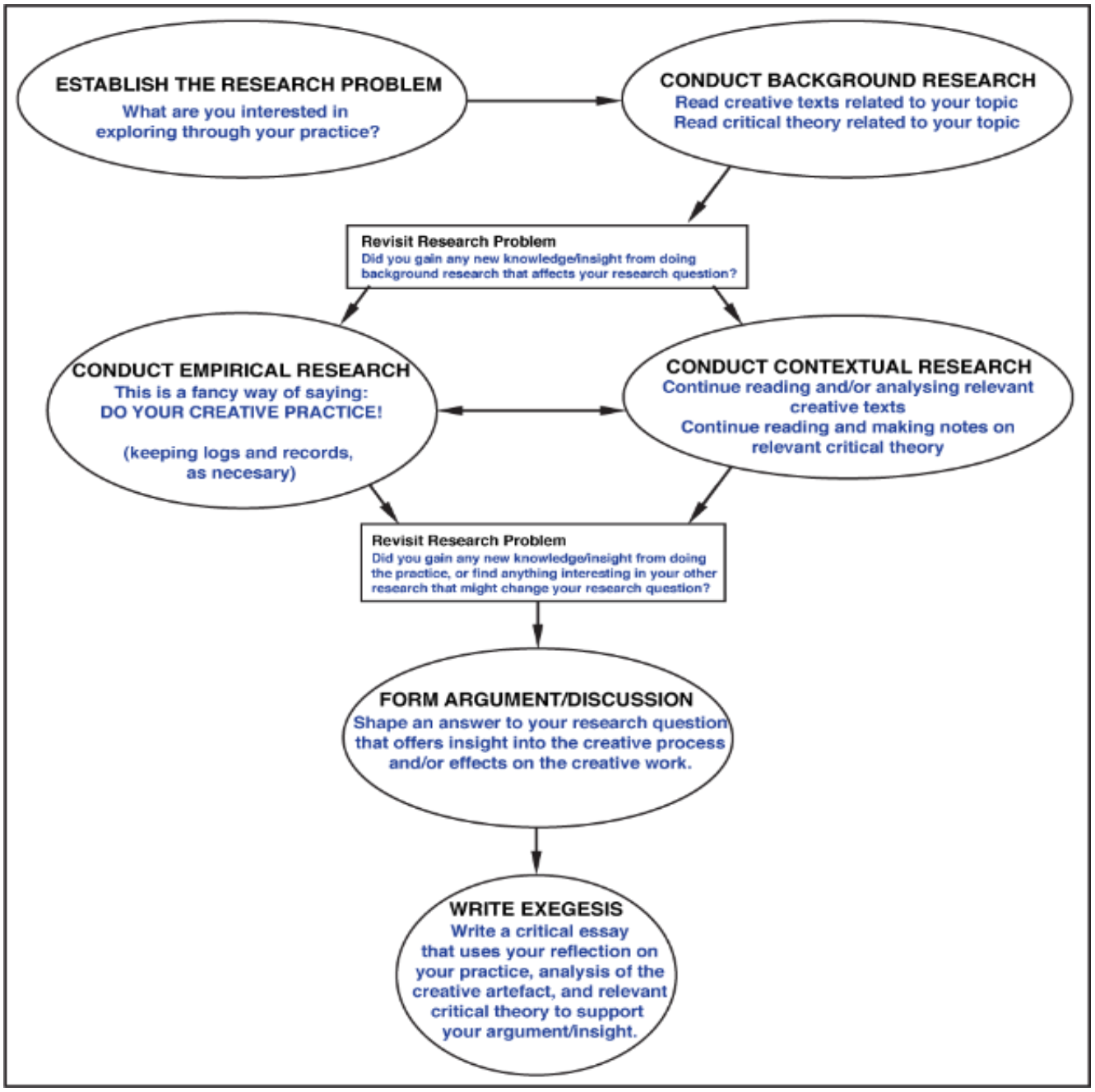


Figure 1-5: Skains' practice-based-research method.[36]

[36] Lyle Skains, "PBR Method," Creative Practice as Research: Discourse on Methodology, accessed July 5, 2021, https://scalar.usc.edu/works/creative-practice-research/media/pbr-method.

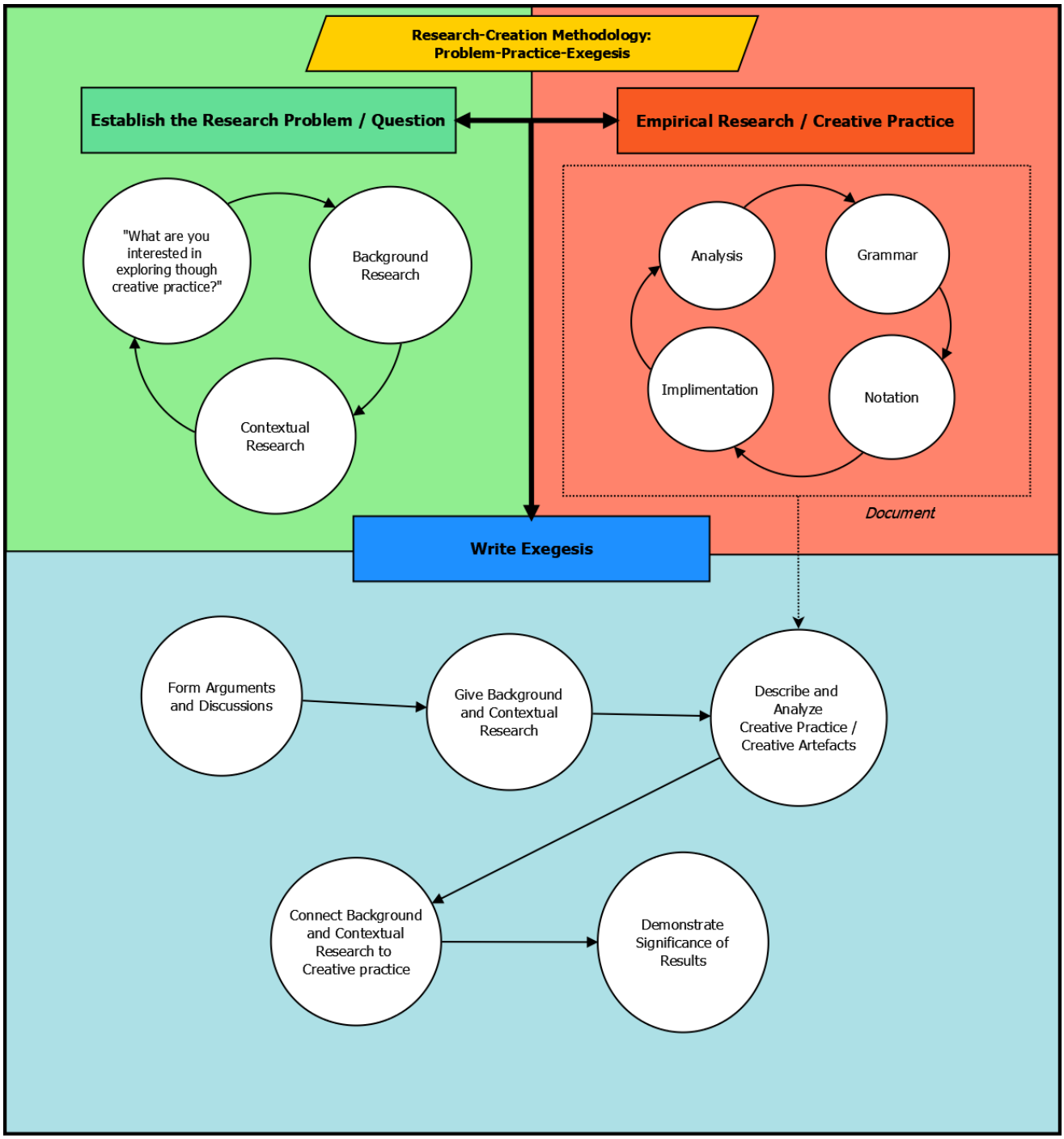


Figure 1-6: Problem-Practice-Exegesis Methodology.

1.3.1 Establishing the Research Problem

During my early days as a DMA student, I improvised a preliminary version of my first feedback saxophone piece. To my colleagues and I, this was a novel approach to saxophone performance, and it quickly overshadowed other potential avenues of research. Answering the question, “what are you interested in exploring through your practice?” helped determine my exact topic. I was

interested in the saxophone and technology, but I needed to narrow to a specific subject, so I began by exploring areas such as interactive media, performer-controlled media, live electronics, and analogue technology.

This background research was conducted while I developed my artistic material and during courses where I was writing papers and giving presentations, whether on feedback saxophone or related topics. I eventually landed on the microphone as the most important piece of technology in my creative practice, after which my contextual research led me to discover microphone performance innovation in a wide variety of musical settings. I eventually discovered the term "microphonic process" to describe what I and many other artists were doing with the microphone and related media. Therefore, my three research goals became: 1) to discuss the history of the microphonic process, 2) to examine how the microphonic process has innovated contemporary saxophone performance practice, 3) to use these findings to contextualize and inform my feedback saxophone practice.

Background and contextual research are not often considered part of methodology, yet these steps inform research questions. This stage of the methodology provides the setting for which the creative practice may be understood: its historical precedent; its relation to artistic traditions and trends; and the degree to which it innovates. Describing how influential artists variously employed the microphonic process demonstrates the historical precedence for my research (Chapters 2 and 3), while examining contemporary examples of the microphonic process as it applies to the saxophone (Chapter 4) contextualizes my claims of novelty and how I expand on the practice (Chapter 5). Like many artist-researchers, these topics and perspectives were not obvious to me at the beginning of my program, and as I learned more, I updated my questions and methods. For instance, I had not discovered any feedback saxophone artists until my second year of studies, despite having done innumerable searches in academic journals, dissertation repositories, and popular search engines. That changed after I discovered the feedback saxophone work of John Butcher, whose name casually came up in conversation with a staff member at the university,[37] and whose work contributes greatly to the topic of the saxophone and

[37] Thanks to Ely Lyonblum.

microphonic process. Although establishing research problems through background and contextual research is not uncommon, addressing the reflexivity of this process is constructive. As many researchers can relate to this process, it emphasizes the legitimacy of a systematic creative practice, as well as the iterative nature of scholarly inquiry itself.

1.3.2 Empirical Research / Creative Practice

This stage of my methodology incorporates AGNI – analysis, grammar, notation, implementation. According to Bhagwati, this process can begin at any point in the cycle and what constitutes each step of the cycle will vary depending on the project. This process is explained in detail in Chapter 5.

1.3.3 Documentation

The importance of documenting this iterative process should not be understated. For most artists, producing clear and thorough documentation is not necessary to convey the value of their work, as the final creative artefact is the goal. For research-creation, however, the project's processes, iterations, failures, and successes must be documented to fully communicate the research, to allow for critical reflection, and to permit its results (whether successes or shortcomings)[38] to be employed by others. This is especially relevant to research involving innovations in music performance technology, as mine does. With rapidly changing technology, many new instruments are rarely played by more than a handful of people, exacerbating the challenge of disseminating such research.[39] Furthermore, electroacoustic music often breaks the link between performer gesture and sonic result, which reduces the effectiveness of audio-visual recordings as reliable sources for critical analysis. All these factors highlight the need for systematic documentation in research-creation. I therefore include audio-visual documentation for three feedback saxophone works I composed and performed, as well as excerpts from the creation process. Documenting my creative practice as described adds to the rigour of the project and

---

[38] Mistakes or unintended results in creative activity can often be just as inspiring as intentional products.

[39] The challenges of which are discussed in: Andrew P. McPherson and Youngmoo E. Kim, "The Problem of the Second Performer: Building a Community Around an Augmented Piano," *Computer Music Journal*, 36, no. 4 (2012): 10-27.

provides deeper access to the research process.

1.3.4 Exegesis

The exegesis remains a fundamental product of scholarly research and should be part of most, if not all, research-creation projects. The increasing occurrence of monographs embedded with multimedia can only signal the importance of non-discursive forms of communication and is an encouraging development for those artist-scholars looking for a more holistic medium through which to present their work. For success in research-creation, Henk Borgdorff suggests that "the researcher is obligated to the research community to situate each study in a broader research context and to elucidate both the process and the outcome in accordance with customary standards."[40] To do so, this thesis follows the steps illustrated in my methodology: I form my arguments in the forward, I have just described my methodology, now I turn to the findings of my background and contextual research, followed by a discussion that connects my creative practice to those findings, ending with an examination of my creative practice and its significance.

[40] Borgdorff, *Conflict of the Faculties*, 25.

2 The Birth of the Microphonic Process: From Gramophone to Crooning

Upon publishing the work *Mikrophonie I* in 1964, the German avant-garde composer Karlheinz Stockhausen (1928-2007) declared, "The microphone has, up to now, been treated as a lifeless, passive recording instrument for the purpose of obtaining a sound playback that is a faithful as possible."[41] In this chapter, I examine how the microphone has been used as a musical instrument as part of the microphonic process long before, and independently of, the composer's work. Rather than focus on the microphone itself, as *Mikrophonie* or the anglicized microphony suggests, the microphonic process places the microphone within an instrumentarium – a collection of tools or equipment expressly gathered to carry out a task. The task for those artists who engage in the microphonic process is to support, expand, and innovate musical practice.

My investigation into the microphonic process begins by defining it using Cathy van Eck's four categories of how microphones and loudspeakers are used as musical instruments.[42] Following this, I introduce the principles behind the most important pre-electrical music technology, the phonograph, as well as the dominant style of singing that it accompanied. Having established pre-electrical music technology and vocal performance, I then detail the advent of the microphone, amplifier, and loudspeaker, and explain how these devices were used by the true pioneers of the microphonic process, early microphone singers. Early microphone singing was exemplified by the seminal American "crooner" Bing Crosby (1903-1977), whose soft, conversational singing technique popularized the microphone and forever changed vocal performance. I describe how Crosby's success ultimately led his revolutionary singing style, and microphone technology, to be assimilated into popular vocal performance. I conclude by arguing that the ubiquity of the microphone influences how it is perceived as an instrument, and that, despite this, it should still be analyzed within the context of a microphonic instrumentarium.

---

[41] Stockhausen, *Mikrophonie I*, 9.

[42] van Eck, *Between Air and Electricity*.

2.1 Microphones and Loudspeakers as Musical Instruments

Using the microphone as a musical instrument may be a foreign concept to those accustomed to the device's ubiquity in musical acts. The microphone is not typically thought of as playing an active role in musical performance and is instead considered a passive tool that simply brings sound to audiences' ears – much in the same way a window displays what is on the other side of a wall, or a clean mirror reflects an image. Close inspection reveals however, that microphones, loudspeakers, and related media have been used as musical instruments since their inception. Discussing how these media are used for explicit musical ends, that is, how they facilitate the microphonic process, is the aim of this section.

Of immense importance to this analysis is *Between Air and Electricity – Microphones and Loudspeakers as Musical Instruments* by Cathy van Eck. In her book, van Eck places the ways microphones and loudspeakers are used as musical instruments in four categories: reproducing, supporting, generating, and interacting.[43] While the principles underlying each category are distinct, in practice they are not always easily distinguishable, and they often overlap. In her study, van Eck does not analyze related media such as amplifiers or mixing boards, which I later argue are vital to the microphonic process. Nevertheless, her categories are useful and are easily adapted to discuss the microphonic process, which considers a wider variety of media.

At the core of these four categories is the degree to which the microphonic process can be perceived or considered to be playing an active role in music performance. To begin then, is the least active of van Eck's categories: reproducing. When the microphonic process is used for reproducing, the involved media are capturing and subsequently mimicking the original sound. Here, the process is intended to be sonically "transparent" in that it is not colouring or altering the sound in any meaningful way. This is the underlying principle of early music recording and contemporary music consumption. In reproduction, pre-recorded material is meant to be played through such transparent loudspeakers, whether in a TV, mobile device, or set of headphones, which are perceived as passive actors that faithfully project this material to the listeners' ears. In performance, the reproducing approach is employed whenever the event features playback of

---

[43] van Eck, *Between Air and Electricity*, 38.

previously recorded material, such as in acousmatic classical music or when “backing tracks” are used in popular music.

Supporting sound (or amplifying sound, as it is commonly understood) was not possible before the invention of the vacuum tube amplifier, as explained below. Once this technology was adopted, electronic amplification allowed sounds from any source to be made louder and heard clearly in large venues or in recordings. Sound reproduction devices used for supporting share a perceived transparency with those used in reproducing, in that they are intended to not colour the sound but simply make it louder. In many instances, performers who use microphones or other amplification, such as with electric guitars, are seen as employing them in a passive, supporting fashion, regardless of the artists’ intentions.

For the generating approach, the source of the sound begins in an electronic medium rather than as air pressure waves, and consequently cannot be heard without the amplifying assistance of the microphonic process. Perhaps the most common example of this approach is in the case of solely electronic musical instruments, such as synthesizers. Synthesizers generate sound through electronic oscillators without producing acoustic sound on their own. These electronic signals are only manifested as air pressure waves once they are sent to an amplified loudspeaker, whether in recording or live performance settings. This perspective could also apply to less “instrumental” devices such as effects pedals, devices which modulate a sound source or generate sound based on an incoming signal. While effects pedals are typically dormant without a sound source, like synthesizers, they do not generate their own acoustic sound and must be amplified via the microphonic process.

An important similarity between these first three categories is that the sound reproduction media used in each may be viewed as passive, transparent actors in the performance of music. At first glance, the microphonic process may be assumed to create an exact reproduction of the source sounds, whether in a different time and space (reproducing), at a greater volume (supporting), or when they manifest electronically generated frequencies as air pressure waves (generating). In these apparent passive roles, it is difficult to consider microphones, loudspeakers, and related media as active components within a musical instrumentarium, but the following example may help illustrate the active role that these media play. Consider the sonic differences between amplifying a synthesizer using the inexpensive headphones purchased on an airplane, versus

amplifying the same synthesizer through an expensive PA system meant for a concert hall. The vast difference in both size and quality of the loudspeakers in each setting would greatly affect the generated sound, influencing the synthesizer's timbre, dynamic range, and emotional impact. The same loudspeaker comparison could be applied in examples of reproducing (e.g., a club DJ), or supporting (e.g., in miking a vocalist). Recognizing the active role that the microphonic process plays in music performance, regardless of the degree, can shift the understanding of microphones and related media away from that of passive reproducers of sound.

Even after recognizing the active contributions of the microphonic process when used in reproducing, supporting, or generating, van Eck's most important instrumental category is interacting. Here, musicians explicitly use, and are perceived as using, the microphonic process in ways that clearly relate to musical events and outcomes. Van Eck states: "By treating these devices as instruments, new aspects of music can be discovered…musician, microphone and loudspeaker can start a complex relationship in which sounds are created from characteristics of the devices themselves."[44] A common example of the interacting approach is when electric guitarists intentionally induce feedback[45] between their guitar and amplified loudspeaker. By interacting with their guitar, loudspeaker, and the space they are in, guitarists transform the loudspeaker from a device that may be perceived as passively amplifying the manipulation of strings, into an active component of their instrumentarium that expands what the guitar is capable of.

Van Eck spends most of her book investigating the interacting approach by analyzing classical pieces that employ the microphonic process in interactive ways. As a classical composer herself, she focuses on works that are considered part of the avant-garde or experimental classical music traditions. However, the advent of microphone singing in the 1920s and the discovery of electric guitar feedback in the 1960s make excellent examples of van Eck's interacting approach within popular music. Van Eck mentions these two historically important performance innovations early in her book, stating that "[amplification] technology had much more impact than solely that of

---

[44] van Eck, *Between Air and Electricity*, 51.

[45] Which is explained in detail in Chapter 3.

increasing the volume of already existing musical instruments."[46] Furthermore, she poses a question regarding the inclusion of popular microphone singing technique within her interacting category, "Should it be said that the use of microphones in *Mikrophonie I* is more instrumental or interactive than, for example when used for the amplification of singers? Why could a singer such as Ella Fitzgerald not being [sic] seen as 'playing' the microphone, as she also changes the distance between her mouth and the microphone to change the quality of the vocal sound."[47]

Focusing on the work of classical artists, van Eck only briefly addresses these important performance innovations in popular music,[48] inviting further inquiry. Rather than debate whether popular microphone singing should be considered interactive when compared to *Mikrophonie I*, I instead view these as manifestations of the microphonic process in different genres, and therefore use van Eck's categories as a framework to discuss how popular and classical artists have variously employed microphonic instrumentaria. By comparing the musical-technological innovations of these disparate artists, my aim is to address the questions raised by van Eck and show that the differences in the microphonic process across genres are much more in degree than in kind. To set the stage for this argument, I turn to pre-electrical singing, acoustical recording, and the advent of the microphonic process.

2.2 The Birth of the Microphonic Process

To understand the significance of the microphonic process and its impact on live performance, it is first necessary to understand pre-electrical audio technology and the singing it captured. The phonograph, commonly known by its trademarked name the Gramophone, was created in 1877 by American inventor Thomas Edison (1847-1931). As the precursor to the modern-day turntable, it was the first commercially successful sound reproduction device and was used in homes to listen to pre-recorded music in the late 19th and early 20th centuries. Its early iterations

---

[46] van Eck, *Between Air and Electricity*, 39

[47] van Eck, *Between Air and Electricity*, 99.

[48] The crux of her argument centres around how the microphones in *Mikrophonie I* are used to discover sounds that would otherwise be inaudible, which she contrasts with how singers use microphones as an extension of their voice. I find this distinction does not hold up when early microphone singing is considered (see below).

played wax cylinders, followed by wax discs, which made way for the vinyl records we know today. Before electricity, phonographs recorded onto and read wax cylinders through acoustical-mechanical transduction and the tympanic principle. To produce recordings on wax cylinders, performers had to play or sing into a large horn, which fed into a sound box featuring a glass membrane or diaphragm. This diaphragm was designed to be like a drum, in that it was tympanic, and vibrated sympathetically to sound waves it encountered. The sound of the performance coming through the horn vibrated the membrane, which in turn vibrated a "cutting needle" that etched deviations into a turning, warmed, wax cylinder. The diaphragm acted in tandem with the cutting needle as a transducer, transforming the sound from one medium, air pressure waves, to another, etched wax. Cylinders of successful recordings could then be mass produced to be purchased and played at home. To listen to these cylinders, the process was reversed. The cylinder, hardened and made for home use, was turned in the phonograph and the etchings were "read" by a stylus. The etchings moved the stylus, the stylus vibrated the tympanic membrane in the sound box, again transducing the etched wax into air pressure waves, which were then finally sent through the horn to the listener's ears.[49]

This early, acoustical method of recording was severely limited in the range of performances it could record. In *Chasing Sound*, Susan Schmidt Horning details how early recording technology created strenuous conditions under which recording artists had to operate. "The limitations of the acoustical recording apparatus demanded that performers adjust playing style, vocal style, and physical movement to accommodate the available technology. These considerations inhibited spontaneity by forcing the performer to divide his or her concentration between artistic interpretation and recall of the 'staging' required before the recording horn."[50] Each step in the acoustical recording process also led to loss of fidelity and the addition of noise to the original performance. To create the best recording then, instrumentalists had to be carefully positioned depending on the dynamic and timbre of their instrument, in necessarily small ensembles.

---

[49] In this case the sound was focused by the horn, mechanically "amplifying" it. van Eck, *Between Air and Electricity*, 14.

[50] Susan Schmidt Horning, *Chasing Sound: Technology, Culture & the Art of Studio Recording from Edison to the LP* (Baltimore: Johns Hopkins University Press, 2013), 21.

Despite working in small rooms designed to produce the best possible recordings, vocalists had to sing loudly and project their voice directly into the horn, as if performing in a large hall, to adequately move the cutting needle to record. The details of soft, nuanced performances simply could not be captured in acoustical recording, and higher pitched instruments, including, sopranos, violins, and flutes, famously sounded poor on early wax cylinders.[51] This "made it impossible for weak, soft, or subtle vocalists to become successful recording artists."[52] The early successful acoustical recording artists, therefore, were ones who could use their powerful performance voices in the studio, such as popular singers like Bessie Smith[53] and classical singers like Enrico Caruso.[54]

Two devices, however, electrified the recording process and, by the late 1920's, made acoustical recordings practically obsolete.[55] The vacuum tube amplifier and the condenser microphone were invented by engineers at Western Electric, a subsidiary of the Bell Telephone Company and AT&T, between 1912 and 1916. The vacuum tube originated in a design that Western Electric purchased in 1913, the *Audion*: an electrical amplification tube created by American scientist Lee de Forest in 1906. At the time of its creation, it was unclear how it could be broadly applied so it was given little attention by those working with sound. When it was improved by the Western Electric engineers and paired with the condenser microphone however, the vacuum tube transformed the entire audio industry, including film, radio, recording, telephone communication, public address systems,[56] and eventually, live performance.

---

[51] Horning recounts a story of how a flutist, upon hearing his sound "as others heard him" for the first time, promptly sold his flute. She also quotes from a phonograph recording instructional book that warned amateurs to "avoid the sorrow that is almost inevitable in attempting to make a record of a high tenor, a soprano or a violin." Horning, *Chasing Sound*, 57-58.

[52] Horning, *Chasing Sound*, 30.

[53] John Potter and Neil F. Sorrell, *A History of Singing* (Cambridge: Cambridge University Press, 2014), 245.

[54] Horning, *Chasing Sound*, 22.

[55] Horning, *Chasing Sound*, 41.

[56] Horning, *Chasing Sound*, 35.

The condenser microphone was an improvement of the carbon microphone that was independently developed by David Edward Hughes, Emile Berliner, and Thomas Edison in the late 19th century. The technical limitations of the carbon microphone prevented it from being widely used in recording, and where ribbon and dynamic microphones were not used until the 1930s, the condenser was the first microphone to revolutionize commercial sound applications. Different types of microphones naturally were, and are, best suited to distinct sound environments and applications, whether in recording, communication, or live performance, but their qualities do not explicitly factor into the microphonic process as I describe. Consequently, I discuss microphones in general, rather than specific types, from here on. Similarly, while vacuum tubes were the first widespread method of electrical amplification, many iterations of the technology followed and operated under similar principals with comparable results. Unless I need to specifically address vacuum tubes, therefore, I will henceforth use the terms amplifiers and amplification to speak about audio amplification devices more generally.

The development of loudspeakers also occurred in the early 20th century and would eventually join the microphone and amplifier in the microphonic process. The first electric speaker capable of producing intelligible speech was patented by Alexander Graham Bell in 1876 for use in telephone earpieces for one person to hear. It would be some time before a true "loudspeaker" – named because it could speak loudly to a room of people rather than a single person – would be used in public. Around the turn of the 19th century, there were several designs of acoustical-mechanical loudspeakers powered by compressed air intended for instrumental amplification and public address, but they ultimately failed to achieve commercial success.[57] The first "moving-coil" or electromagnetic speakers, which modern loudspeakers are based on, were developed by Peter Jensen and Edwin Pridham in California, 1915. Instead of creating speakers for use in telephone systems, they invented the first public address (PA) system by combining their loudspeaker technology with microphones and amplifiers. That same year, their company Magnavox demonstrated their PA system to a crowd of 100 000, in what was perhaps the first

[57] A detailed account of acoustical-mechanical amplification can be found in Aleksander Kolkowski and Alison Rabinovici, "Bellowphones and Blowed Strings: The Auxeto-Instruments of Horace Short and Charles Algernon Parsons," in *Material Culture and Electronic Sound*, eds. Frode Weium and Tim Boon (Washington, D.C.: Smithsonian Institution Scholarly Press, 2016): 1-42.

ever public amplified music performance, at a caroling event at San Francisco's new Civic Centre.[58] While Jensen and Pridham may have been the first to publicly demonstrate the "miracle"[59] of amplified sound projection, because they failed to patent their speaker technology, it is Edward W. Kellogg and Chester W. Rice who are credited as the true trailblazers. The latter pair's 1925 patented loudspeaker was the design that went on to achieve commercial success, transforming the musical landscape.

Combining the microphone, amplifier, and loudspeaker enabled what continues to be one of the most important functions of electronic media in audio: making sounds louder. Much like the phonograph, these media employ transduction and the tympanic principal. Sound waves encountered by a microphone excite a small, tympanic diaphragm within it, transducing air pressure waves into an electrical signal. The electrical signal is then boosted by an amplifier, vibrating a much larger loudspeaker diaphragm, transducing the electrical signal back into air pressure waves with a greater volume than the originals. This process, carried out by Jensen's and Pridham's PA system in 1915, enabled the large crowd in San Francisco to easily hear caroling from a great distance. These new media also impacted recording by allowing for larger ensembles of a wider variety of instruments, and freed singers and soloists from obsessing over the recording horn. This new "Electrical Process" also captured a wider range of dynamics and produced recordings with higher fidelity and far less noise.[60]

Early iterations of these technologies were incapable of capturing the full range of singing, making it perhaps acceptable for an amateur public caroling event, but unfitting for professional artists. The apprehension many musicians felt towards the recording horn of the acoustical

---

[58] Andy Coules, "The History of Live Sound – Part 1," Harman Professional Solutions – Insights, accessed April 13, 2023, https://pro.harman.com/insights/av/the-history-of-live-sound-part-1/.

[59] Coules, "The History of Live Sound."

[60] Horning, *Chasing Sound*, 41.

process continued with the appearance of the microphone, leaving some intimidated.[61] Singers who were undeterred by the microphone's presence and limitations learned to use softer dynamics and a narrower range for successful performances. These early "microphone singers" went beyond using the new media in a supporting or reproducing approach, and instead explicitly interacted with the microphone using modified vocal technique. According to Horning, "The [amplified] microphone afforded more intimacy, capturing more subtleties in the vocalist's performance. Beginning in 1925, singers such as 'Crooning Troubador' Nick Lucas, 'Whispering' Jack Smith, and Gene Austin had begun to capitalize on the microphone's sensitivity, singing in ways that would never have gained them entry to an acoustic recording studio."[62] This was the birth of the microphonic process.

Using the microphonic process, singers no longer had to project in halls to compete with large ensembles and, in recording, they could sing softly without concern of moving the needle or being drowned out by loud instruments. Contrary to Stockhausen's claim that he was animating the microphone from its former "lifeless, passive"[63] state, the microphonic process began with these early microphone singers, some 40 years before *Mikrophonie I*. To understand how the microphone lost its perception as an active musical instrument, even among professional musicians, I now turn to the seminal crooner, Bing Crosby.

2.3 Bing Crosby and the Ubiquity of Microphones

The advent of the microphone, amplifier, and loudspeaker freed singers from the confines of acoustical recording and the need to physically project their voices, leading them to become the first artists to employ the microphonic process in live performance. In the 1920s there were a growing number of singers who were known for their use of the microphone, but it was Bing Crosby who fully harnessed the microphonic process to master the microphone as a musical

---

[61] Some radio studios disguised microphones as lamps so as not to intimidate singers. In: Paula Lockheart, "A History of Early Microphone Singing, 1925-1939: American Mainstream Popular Singing at the Advent of Electronic Microphone Amplification," *Popular Music and Society* 26, no 3 (2003): 371.

[62] Horning, *Chasing Sound*, 45.

[63] Stockhausen, *Mikrophonie I*, 9.

instrument. Harry Lillis "Bing" Crosby Jr. (1903-1977) was an American singer, actor, and media star whose work topped charts in record and film sales, as well as radio ratings, between 1930 and the 1950s. In contrast to the projecting approach of acoustic singers at the beginning of his career, Crosby "crooned" into the microphone with a conversational singing style that employed much softer dynamics and a lower, narrower range.

> Crosby had sung without a microphone at the start of his career (often using a megaphone); although his early recordings with the [Paul] Whiteman band feature his high head voice and falsetto registers he was…more of a light baritone than a tenor, and his voice became richer and deeper as he got older. [Using the microphone] he extended the head voice downwards, enriching the tone but not sufficiently to give the illusion of a classical baritone, creating a sound that was very close to his speaking voice. He used the microphone with complete mastery, extending [early microphone singer Al] Bowlly's technique into an even more mannered delivery underpinned by consummate breath control.[64]

Crosby harnessed the limitations of early microphone technology to develop this new vocal style[65] and while he was not the only well-known crooner,[66] he codified the vocal style and its associated image[67] to elevate it to become a sensation in popular vocal performance, going on to influence singers such as Frank Sinatra and Michael Bublé. While crooning began as a distinct popular vocal style closely related to the microphone, as Crosby's fame grew and technology developed, the microphone became fully integrated into vocal performance practice in nearly all forms of music. "As these singers performed more and more, they developed their microphone styles until the loud 'premicrophone' singing of only ten or fifteen years earlier must have

---

[64] Potter, *A History of Singing*, 246.

[65] Gary Giddins, "Bing Crosby, The Unsung King of Song," New York Times, accessed April 17, 2019, https://www.nytimes.com/2001/01/28/books/music-bing-crosby-the-unsung-king-of-song.html.

[66] Rudy Vallée was one of Crosby's contemporaries whose significant contributions to popular vocal singing, not having anywhere near the commercial success of Crosby, have received far less attention.

[67] The social context of crooning and how Bing Crosby transformed it is detailed in Allison McCracken, "'God's Gift to Us Girls': Crooning, Gender, and the Re-Creation of American Popular Song, 1928-1933," *American Music* 17, no. 4 (1999): 365-95.

seemed aesthetically passé, bombastic, and abrasive."[68] As with any paradigm shift, microphone singing began as a revolutionary phenomenon but soon became normalized. By the mid 20th century, the ubiquitous microphone no longer innovated vocal performance practice as it did in the 1920s and 30s, consequently changing its perception as an interactive musical instrument to that of a tool that passively supported the voice.

This loss of perceived instrumentality points to why van Eck questioned how Ella Fitzgerald could be perceived as not playing the microphone, as well as Stockhausen's claim of pioneering the use of the microphone as an instrument. Their perspectives do not accurately reflect the history of the microphonic process, as I have discussed, and even counter attitudes in contemporary classical vocal practice. A brief conversation with any classically trained opera singer reveals a world of difference in technique, not to mention aesthetic, between acoustic singing meant to project to a large audience and microphone singing. Since Bing Crosby used, and was perceived as using, the microphone as an instrument, Ella Fitzgerald and other jazz and popular singers should be similarly considered. Though it is beyond the scope of this chapter, there of course was someone who first manipulated the distance between the microphone and their mouth for various timbral and dynamic effects (to reference van Eck's example) – the fact that this technique was standard practice by Fitzgerald's time does not lessen the microphone's instrumental nature, nor should it discourage in-depth analysis of the microphone as part of a microphonic instrumentarium.

While the first popular musician to fully embrace and codify the microphonic process was Bing Crosby, his successors like Ella Fitzgerald employed it as well, albeit not in ways that transformed their practice. Granting such a perspective to popular microphone technique, however, undermines analyses that do not adequately consider non-classical musical-technological innovations. Considering this, do Stockhausen's claims of innovation in *Mikrophonie I* hold up to scrutiny?

---

[68] Lockheart, "A History of Early Microphone Singing," 380.

3 Microphonic Instrumentaria

Building upon my analysis of the advent of the microphonic process, represented by Bing Crosby and early microphone singing, in this chapter I investigate how three artists divergently engaged with microphonic instrumentaria. First, I return to Karlheinz Stockhausen, who coined the term microphonic process, and his work *Mikrophonie I*. Then I discuss Hugh Davies' *Quintet* (1968), a ground-breaking composition that explored indeterminate acoustic feedback between microphones and loudspeakers. Lastly, I examine electric guitarist Jimi Hendrix (1942-1970), who revolutionized rock'n'roll through his use of "harmonic" feedback between his guitar and amplified loudspeaker. These analyses expand how the microphonic process can be understood and introduce differences between microphonic pieces and microphonic practices.

3.1 Stockhausen's *Mikrophonie I*

Stockhausen created the term *Mikrophonie*, or microphony, to describe the foundational process of his pieces *Mikrophonie I* and *Mikrophonie II*. The term *Mikrophonie* references the practice of using microscopes, or *Mikroskopie*, which magnifies things that the naked eye cannot see. Unlike the microscope, which reveals what is already present but in higher detail – a visual corollary to van Eck's supporting approach – Stockhausen's intent was to use the microphone to create new sonic experiences. "The microphone...would have to become a musical instrument and, on the other hand, through its manipulation, influence **all** the characteristics of the sounds. In other words, it would have to participate in forming the pitches – according to composed indications – harmonically and melodically, as well as the rhythm, dynamic level, timbre and spatial projection of the sounds."[69]

Using the microphone this way, in what he later called the microphonic process, the composer suggested he was pioneering the microphone as an active musical instrument, in stark contrast to

[69] Stockhausen, *Mikrophonie I*, 9.

its former use as "a lifeless, passive recording instrument."[70] His attitude towards the microphone can be explained in terms of van Eck's categories: that he viewed it as only being used in a supportive function rather than in an explicitly interactive manner. As I discuss in the previous chapter, the history of microphone singing shows otherwise. Furthermore, the microphonic process does not employ the microphone alone, but rather an instrumentarium of media that includes microphones, amplifiers, loudspeakers, and other media. Despite the inaccuracy of Stockhausen's claims, examining how *Mikrophonie I* employs a microphonic instrumentarium reveals the work's contributions.

Mikrophonie I was written for six musicians divided into two groups of three players, each consisting of a percussionist, playing a single tam-tam (a non-pitched, flat metal disc used in orchestral percussion); a "microphonist," who is onstage manipulating a microphone; and a technician, who is set up in the audience controlling a "band-pass" filter and volume faders – what today would be referred to as a mixing console (and the term I will use when referring to both items). The process of sound production for each group is as follows: the percussionist interacts with the tam-tam; this sound is acoustically projected into the space while also being captured by the microphonist at varying positions; then the signal from the microphone is manipulated by the technician using the band-pass filter; this modified signal is sent to two speakers via two volume faders, finally disseminating the electroacoustic sound into the performance space via loudspeakers (fig. 3-1).

With regards to the only acoustic instrument involved, the tam-tam, Stockhausen has admitted that the piece could be performed with or "on" any interesting metal object, "I can imagine the score being used to examine an old Volkswagen musically, to go inside the old thing and bang it and scratch it and do all sorts of things to it."[71] Whether a tam-tam or automobile, the acoustic sound of the percussion instrument is still audible alongside the electro-mechanical transformations made by the microphone and mixing console. While for many percussionists the tam-tam is of the utmost importance for interpreting this piece, Stockhausen's own statements

---

[70] Stockhausen, *Mikrophonie I*, 9.

[71] Stockhausen, *Stockhausen on Music*, 7.

highlight the original intent of the piece, that it is about acoustically exploring a percussion instrument *or* metal object by means of the microphonic process. Stockhausen notates two parameters for microphone placement, the distance from the percussion object used to interact with the tam-tam (while still being near the tam-tam itself) and the distance away from the tam-tam, with each parameter having three subdivisions of distance.[72] Microphone placement inherently influences the quality and volume of captured sound. Van Eck explains that "The closer the microphone is to the object, the more prevalent high frequencies will be in the sound, since rapid air pressure waves decay the fastest. When the microphone is placed further away from the object, there will be not only fewer high frequencies but also more sound input from the space present in the resulting sound."[73]

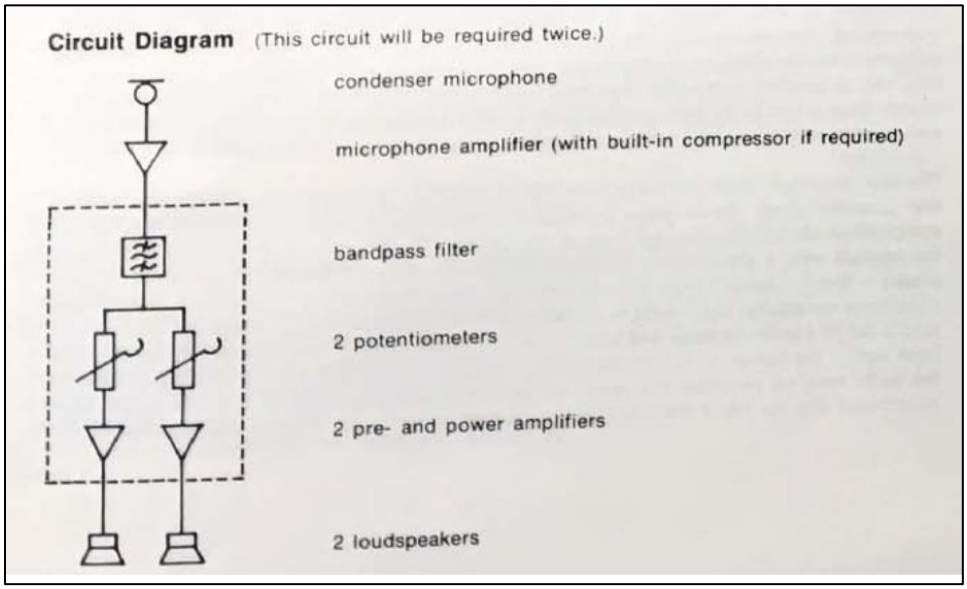


Figure 3-1: Circuit Diagram for *Mikrophonie I*.[74]

Rather than being unique to *Mikrophonie I*, electro-mechanical equalization is a natural phenomenon of all microphones, and therefore the microphonic process. This was present as

---

[72] Stockhausen, *Mikrophonie I*, 14.

[73] van Eck, *Between Air and Electricity*, 97.

[74] Stockhausen, *Mikrophonie I*, 10. This shows the audio signal chain for the microphonists and mixing board operators.

Bing Crosby was developing crooning and when Ella Fitzgerald manipulated the distance of the microphone from her face, further supporting the idea that microphone singers engage in the microphonic process. Still, *Mikrophonie I* is notable in that it "requires rapid and virtuoso" [75] microphone movements according to the score. The piece also requires similar techniques on the mixing console, which despite the piece's theoretical focus on the microphone, plays a vital role in its instrumentarium.

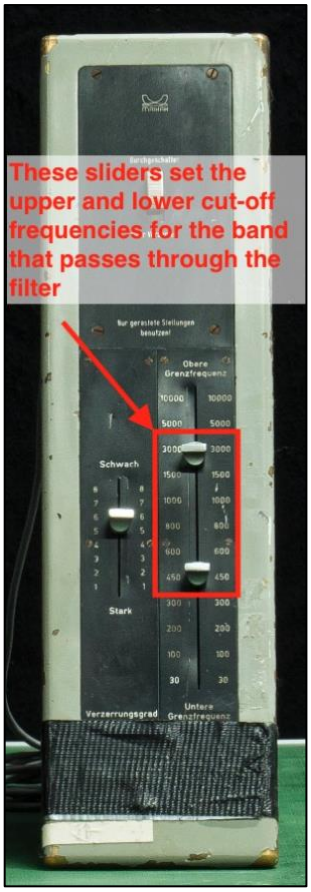


Figure 3-2: The W49 band-pass filter.[76]

To form the mixing console used in *Mikrophonie I*, a W49 *Hörspielverzerrer* filter was bolted to two W66C volume faders, both of which were manufactured by the German firm Maihak. The faders control the volume of the sound leaving the filters and heading to each of the speakers.

---

[75] van Eck, *Between Air and Electricity*, 97.

[76] "W49 Hörspielverzerrer," Google Arts and Culture, accessed March 23, 2023, https://artsandculture.google.com/asset/w49-h%C3%B6rspielverzerrer-firma-h-maihak-ag-hamburg/-QGxLY3VP63lfg?hl=en. Notations my own.

Today, volume faders are found on all sorts of physical and digital interfaces, from home stereos to digital audio workstations – on the former, appearing as volume knobs; on the latter, appearing as digital sliders. The W49 filter was designed to be used in radio programs to create effects on the voice, mimicking acoustic environments such as talking on the phone. To accomplish this, it acts as a sieve for sound, electronically blocking some frequencies while permitting others through. Filters such as the W49 are categorized by the range of frequencies they permit through, such as "band-pass," "high-pass," and "low-pass." For instance, a high-pass filter allows sound above a "cut-off" frequency through the sieve, meaning they generally suppress low frequencies only. The opposite is true of a low-pass filter – it suppresses high frequencies. The W49 is a band-pass filter, meaning that upper and lower cut-off frequencies create a band of sound between the cut-offs that is allowed through the filter. The W49 accomplished this through two sliders on a vertical scale, with the top and bottom sliders setting the upper and lower cut-off frequencies respectively. As figure 3-2 shows, the W49 was also a "step-filter," meaning that the cut-off frequencies were set according to pre-determined steps.

Within the *Mikrophonie I* mixing board, the volume faders are used in a typical, if virtuosic, fashion, to manipulate the volume coming out of the loudspeakers. The writing of Sean Williams reveals much about how Stockhausen used the W49 filter.[77] Stockhausen frequently used this filter in his works, first using it in *Kontakte* in 1959, then regularly starting in 1964 with *Mikrophonie I* and continuing with *Hynmen* (1966), *Prozession* (1967), *Kurzwellen* (1968), and *Aus den Sieben Tagen* (1968). Figure 3-3 shows an excerpt of the filter notation in *Mikrophonie I*, where the smooth, diagonal lines direct the technician to fluidly move in between the steps, rather than set the cut-off frequencies according to its built-in steps.

---

[77] Sean Williams, "Stockhausen Meets King Tubby's: The Transformation of the Stepped Filter into an Instrument," in *Material Culture and Electronic Sound*, eds. Frode Weium and Tim Boon (Washington, D.C.: Smithsonian Institution Scholarly Press, 2016): 159-184.

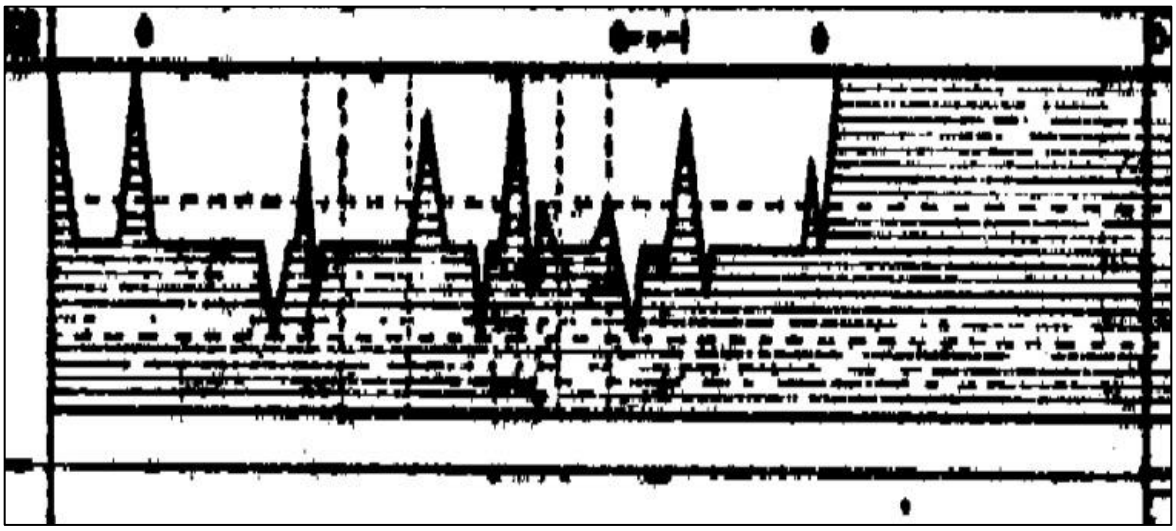


Figure 3-3: Sample notation for the W49 filter.[78]

Using the filter in such a way, however, causes it to elicit "clicks, crackles, and pops" which are only made stronger over time by the temporary relief that lubricant spray provides. These "extraneous" sounds have since become an important part of historically informed interpretations of the work.[79] Stockhausen believed that the idiosyncratic sounds created by using the limited equipment outside of its design were essential: "Such materials are glorious, aren't they? The two metal levers of the filters scrape along on the carbon strips, and spray must now and then be used. Today, if you try to substitute computerized filter simulations, the characteristic sound goes to hell."[80] According to Williams, "The repurposing of the W49 filter is therefore consistent with the approach demonstrated throughout the piece in which Stockhausen is pushing each performer to extend the music-making potential of each instrument or tool in order to create a larger, polyphonic sound that goes beyond any of the individual elements comprising it."[81]

---

[78] Stockhausen, *Mikrophonie I*, 27. The shaded/lined area is the band of sound allowed through the filter. The diagonal lines indicate that the filter is meant to be moved smoothly through the steps, a technique outside of its design.

[79] Williams, "Stockhausen Meets," 180.

[80] Karlheinz Stockhausen and Jerome Kohl, "Electroacoustic Performance Practice," *Perspectives of New Music* 34, no. 1 (1996): 97.

[81] Williams, "Stockhausen Meets," 167.

All of this reinforces why *Mikrophonie I* can be viewed as a highly interactive piece of music over 60 years after its premiere. Why then can the instrumental nature of the microphone in the hands of popular artists, such as Bring Crosby, be overlooked? Partly, this can be explained by pieces and practices. Believing that "If it is imitable, then it is also not worth much,"[82] the enduring novelty of Stockhausen's work relates to his intention to develop a piece using techniques never meant for mass adoption. The source sounds from the tam-tam are not produced in a manner typical of its orchestral setting, while microphonist was not, and is not, a common role within music performance, notwithstanding the degree to which vocalists engage in the microphonic process. Moreover, the sound resulting from the interactions between the tam-tam, percussionist, and microphone are shaped by virtuosic and unconventional actions on the mixing board in ways rarely seen today. Conversely, Crosby, not being a composer at all, instead developed a microphonic practice that was adopted throughout popular singing. He found a balance between new technology and musical taste, performing songs using his new practice that were already well known or had the potential to become commercially successful, and therefore broadly impacted vocal performance. These varying intentions and outcomes heighten the perceived interactive/instrumental nature of *Mikrophonie I* and obscure the instrumental innovations of popular microphonists like Crosby and Fitzgerald.

Considering these cases as differing examples of the microphonic process opens up *Mikrophonie I* to further scrutiny. The work did not reimagine the microphone as an active musical instrument – this had already been done by early microphone singers and later vocalists. If it is microphone virtuosity that makes the work unique then, one would only need to find examples of popular singers making rapid motions with the microphone to call into question the piece's original contributions. Perhaps it was instead Stockhausen's use of the mixing console that should receive attention? Continuing this line of inquiry, Williams' work shows that Jamaican producer King Tubby (1941-1989) similarly employed a step-filter in dub reggae of the 1960s.[83] Furthermore, master hip-hop turntablists of the 1980s and 90s, such as Grand Master Flash (b. 1958) or the X-

---

[82] Stockhausen and Jerome Kohl, "Electroacoustic Performance Practice," 97.

[83] Williams, "Stockhausen Meets," 159-184.

Ecutioners (active 1989-2005) used mixing consoles with incredible technical prowess. Such comparisons undermine van Eck's vaulting of *Mikrophonie I* to a higher level of interactivity than that of popular microphone practice and also reveal how an overt focus on the microphone does not serve a thorough understanding of the piece. While these facts may refute claims of superiority or originality vaunted upon (or made by) Stockhausen in one particular area, they do not lessen the significance of his contributions to avant-garde classical music. In this sense, analyses of the microphonic process should, therefore, not be done to qualitatively evaluate the instrumentality of a single device between musical contexts, as the work of van Eck suggests, but rather be used to understand how the entire microphonic instrumentarium relates to the genre's conventions.

Analyzing every medium and interaction within microphonic pieces and practices, whether popular or avant-garde, is a challenging and complex endeavour. While I have provided some insight into the previous examples, there is much more that could be said. For example, why have I not discussed the role of loudspeakers? Surely the loudspeaker would have affected the perception of Crosby's voice on the radio in the 1930s, and similarly, Stockhausen would have preferred certain loudspeakers over others, having deliberated over almost every other detail. While loudspeakers would have played an active role in the production of sound in these cases, the performers did not interact with them for explicit musical ends. This points to the importance of van Eck's interacting category in conceiving of sound reproduction media as musical instruments and examining the microphonic process. Without real or perceived interactions between performer and media, the instrumental nature of the device is weakened or hidden, as demonstrated in this chapter. To examine the role of loudspeakers the microphonic process then, I discuss Hugh Davies' classical work *Quintet,* followed by the electric guitar-feedback pioneer Jimi Hendrix.

3.2 Hugh Davies and Feedback Composition

Acoustic feedback, also known as the Larsen effect, is a phenomenon that was first discovered by Danish physicist Søren Absalon Larsen (1871-1957). Acoustic feedback occurs when a "resonant frequency" is captured by a microphone, it is then emitted from an amplified loudspeaker, and then picked up and projected by the same microphone and loudspeaker, creating a cycle of continuous amplification that often results in a high-pitched ringing. Resonant

frequencies are those that are most easily excited within an acoustic environment, and are influenced by the dimensions, material, and electrical components within the feedback loop.

Acoustic feedback is often the product of a mistake – when a microphone is too loud, or it is inadvertently pointed towards, or placed too close to, a loudspeaker – so it looms over any musical setting that involves high volumes and the miking of acoustic instruments. Despite the risks, musicians have nonetheless been fascinated with this "fundamental sound of electronic music."[84] Hugh Davies (1943-2005) was a British composer and musical instrument inventor who was inspired by such mistakes while he was rehearsing with Stockhausen for a performance of *Mikrophonie I.*[85] Davies channeled these experiences into his 1968 work, *Quintet (Alstrabal...)*. I was unable to procure a digital copy of this score and there are no physical copies in Canada, so I will be relying on secondary sources for this examination, including van Eck's analysis and articles by Hugh Davies scholar, Dr. James Mooney.

According to Mooney, *Quintet* is written for "5 performers, 5 microphones, sine/square-wave generator, 4-channel switching unit, potentiometers, amplifiers, and 6 loudspeakers."[86] The premise of the piece centres around microphonists producing feedback that is influenced by a mixing board. In *Quintet*, as in *Mikrophonie I*, performers move their microphones according to instructions in the score. Unlike the highly detailed score of *Mikrophonie I*, Davies directs performers in a general fashion, such as "move the microphone slowly in different directions, producing increasingly wider pitch intervals."[87] These generalized instructions are needed to accommodate acoustic feedback pitches that will differ with every performance, depending on the room, audience, and more. While any through-composed piece involving human players will vary between performances, the complete pitch indeterminacy of Davies' *Quintet* places it in the

---

[84] van Eck, *Between Air and Electricity*, 58.

[85] James Mooney, "The Hugh Davies Collection: live electronic music and self-built electro-acoustic musical instruments, 1967-1975," *Science Museum Group Journal* 7, Spring (2017).

[86] James Mooney, "Grey Area performs: Hugh Davis, Stockhausen, Christian Wolff, Owen Green," Program notes for *Quintet*, 5.

[87] van Eck, *Between Air and Electricity*, 84.

category of "process music." Process music is an approach to composition whereby the composer dictates the actions that the musician must carry out, as opposed to the sounds that must be produced. This approach is especially suited to works that explore acoustic feedback and other indeterminate musical processes, such as *Cartridge Music* (1960) by John Cage (1912-1992), *Pendulum Music* (1968) by Steve Reich (b.1936), *Bird and Person Dyning* (1975) by Alvin Lucier (1931-2021), and *Spiral* (1968) by Stockhausen.

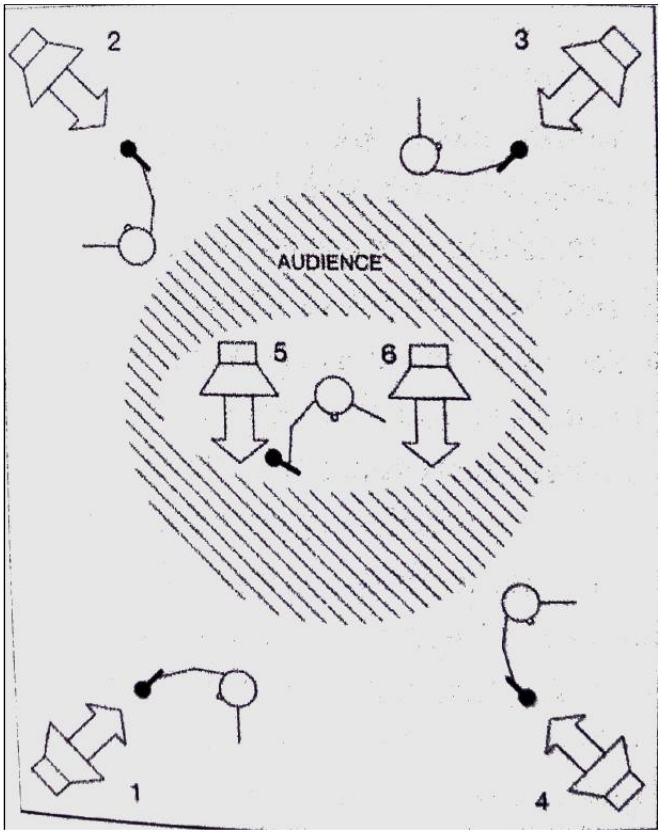


Figure 3-4: Stage plot for *Quintet.*[88]

Like *Mikrophonie I*, the microphonic instrumentarium of *Quintet* also includes a mixing console. *Quintet*'s stage plot (fig. 3-4) depicts four microphonists surrounding the performance space with a fifth in the audience itself. This fifth performer "also operates other electronic equipment so as to alter the characteristics of the feedback sounds, in a 'solo' that happens around four-and-a-half

[88] van Eck, *Between Air and Electricity*, 85. The microphonist in the audience is also the one who operates the mixing board.

minutes into the piece."[89] Part of this "other electronic equipment," what I refer to as the mixing board, is a sine/square wave generator that is used in the following way:

> If the sound generated by an electronic sine/square wave generator is projected via the loudspeaker at the same time as it is producing acoustic feedback, then the generator sounds and the feedback sounds will interact with each other. The effect is similar in principle to ring-modulation – i.e. it is as though the feedback sounds are being ring-modulated with the generator sounds – except that the modulation occurs without the use of a ring modulator circuit.[90]

In addition to the wave generator, the mixing console of *Quintet* is comprised of two loudspeakers, a 4-channel switching unit, as well as the necessary potentiometers (volume faders) and amplifiers. Continuing her focus on the microphone, van Eck omits this piece's mixing console in her discussion. Considering how easily the sonic characteristics of *Quintet* could be interpreted as deriving only from the visible interactions of the microphonists, such an oversight hampers a full understanding of the work. While the mixing board's instrumental nature is not made explicit through easily identifiable performance gestures, it nevertheless plays a vital role in the piece. Without any acoustic sound sources, *Quintet* achieves a more convincing version of Stockhausen's *Mikrophonie* concept: the primary sounds are those resulting of the microphone and the loudspeaker interacting, rather than the microphone amplifying and shaping the sound of another instrument. Regardless of the virtuosity of the microphone movements in *Mikrophonie I*, they could be perceived as "only" supporting the sound of the tam-tam. Moreover, without any traditional instrument in *Quintet*, there is no question as to the instrumental nature of the microphone-loudspeaker relationship.

In the latter years of the 1960s, when Davies composed this seminal avant-garde work, popular artists were also exploring the expressive capabilities of feedback. As described earlier, acoustic feedback is typically the product of a system involving a microphone and loudspeaker, but it can also occur when the microphone is replaced with another sound capturing medium, such as the "pickup" on an electric guitar. The British pop group The Beatles may have been the first well-

---

[89] Mooney, Program Notes, 6.

[90] Mooney, "The Hugh Davies Collection," endnotes.

known band to use feedback between a pickup and loudspeaker in their recording *I Feel Fine*, but it was electric guitar virtuoso James Marshall Hendrix, better known as Jimi Hendrix (1942-1970), who brought feedback into mainstream rock'n'roll performance practice.

3.3 Jimi Hendrix and Two Types of Feedback

Jimi Hendrix was an American guitarist who, despite a brief, four-year professional career at the end of his life, is considered one of the most influential artists in the history of popular music. In the same way Bing Crosby forever changed popular singing, Hendrix employed the microphonic process to transform popular electric guitar performance practice. Of his many contributions, it was his use of feedback between his electric guitar and amplified loudspeaker that is most relevant to this discussion. Understanding the electric guitar, therefore, is the first step in examining his work. This description will draw from the fundamentals of sound, which I cover in Chapter 2.

The electric guitar is a hybrid acoustic-electric instrument whereby sound is first generated acoustically by the strings and then amplified electrically. The chain of sound generation is as follows: the strings are manipulated by the fingers or a plectrum (commonly known as a "pick"), and the strings' vibrations are transformed to an electric signal by electromagnetic transducers ("pickups"). This electrical signal leaves the guitar by means of a cable, where it is sent to an amplifier and loudspeaker.[91] The amplifier boosts the electrical signal, which then vibrates the loudspeaker's diaphragm to finally transform the electrical signal into air pressure waves. The guitar that Jimi Hendrix most often used was a Fender Stratocaster. Much could be said about the design of the "Strat," which is now an industry standard for electric guitars, but for the purposes of this discussion its basic components are all that need to be understood. [92] It has the customary six strings, a solid wood body, three pickups, a pickup selector switch, a volume knob, two tone knobs, a vibrato arm, and a ¼" output.

John Hanford analyzes the guitar virtuoso in his dissertation, "With the Power of Soul: Jimi

---

[91] When housed within the same cabinet, these are called amplified loudspeakers or "combo amps."

[92] A gallery of images of the Strat Hendrix used can be found at: https://www.mattsguitar.shop/en/vendues/fender-stratocaster-1963-jimi-hendrix.

Hendrix in the Band of Gypsys [sic].” The following summary communicates how profoundly innovative[93] Hendrix was understood as:

> Hendrix’s playing was staggering for both its originality and its full command of idiomatic expressions in rock, blues, and rhythm and blues. Most astonishing, though, was the array of new sounds coming out of his guitar; sounds that were overtly electronic and “futuristic” but primal in their affect. Weirdly beautiful, and sometimes of fearsome intensity, they passed by all understanding of conventional frames of reference for guitar playing.[94]

Like Crosby, Stockhausen, and Davies, Hendrix created these “futuristic but primal” sounds using an instrumentarium of media, expanding what the electric guitar was capable of. At the centre of this instrumentarium was the electric guitar and its components as listed above, which he manipulated through techniques uncommon to rock’n’roll at the time, such as tapping, plucking, and shaking. He also employed custom-made effects pedals to modify the electrical signal of his guitar, expanding his sonic palette. Most importantly, however, was how Hendrix exalted his amplifier[95] to become an integral piece of his instrumentarium and therefore rock’n’roll guitar performance practice. He was, among other electric guitarists in the 1960s,[96] famous for employing the “Marshall stack” in live performances. This amplified loudspeaker was designed in 1965 by British instrument manufacturer Marshall to have an imposing physical stage presence and to deliver incredibly high volumes.[97] It is nearly 3’ wide and over 6’ tall, consisting of an amplifier on top of two stacked cabinets, each with four 12” loudspeakers inside. While performing at very high volumes was (and is) a common trait for rock guitarists, Hendrix

---

[93] Besides how Hendrix incorporated various media with his guitar, his physical setup was extraordinary: Hendrix was left-handed but played a right-handed guitar with the strings in reversed order.

[94] John C. Hanford I.I.I., “With the Power of Soul: Jimi Hendrix in Band of Gypsys” (PhD diss., University of Washington, 2003), 23.

[95] I will use the term “amplifier” to denote amplified loudspeaker in discussions involving the electric guitar.

[96] Pete Townsend is another famous guitarist to employ the Marshall stack.

[97] Hanford I.I.I., “With the Power of Soul,” 31.

was famous for his especially loud performances.[98] The high volume he used not only provided an overwhelming experience for the audience but was technically functional in that it enabled his unconventional techniques to be clearly heard.[99] In addition to its imposing stage presence, the amplifier's size meant that much of its output could be directed towards the body of the guitar itself. This facilitated its most instrumental use in performance: acoustic feedback.

Guitarists necessarily divide acoustic feedback into two categories, "microphonic feedback," also sometimes referred to as microphony; and simply "feedback," which is occasionally called harmonic feedback. I use the terms microphonic feedback and harmonic feedback to distinguish between the two.[100] While both forms of feedback adhere to the principles I outlined earlier, that of resonant frequencies being cyclically reinforced, the difference between them lies in whether the pickups or the guitar strings are the medium of reinforcement. In microphonic feedback, the wires in a guitar pickup vibrate from the sound coming from the amplifier. These wires are not designed to vibrate at all, let alone at a set frequency, so when they are subjected to incredibly high volumes, they act like a microphone and reinforce any resonant frequency in the system. Like most other acoustic feedback tones, the pitch resulting from microphonic feedback is indeterminate and often high and loud. Guitar pickups are often treated with wax on the inside to prevent this from constantly happening at high volumes.

Harmonic feedback occurs when the sound from conventional guitar string manipulation is amplified at such an intensity that the sound from the amplifier vibrates the string in turn, sustaining the initial note at pitch. Depending on the positioning of the guitar relative to the amplifier, harmonic feedback can also vibrate strings at higher overtones not available through conventional playing, as well as cause sympathetic vibrations in other strings. This style of feedback is somewhat predictable as it is related to the strings of the guitar, but can be disrupted

---

[98] In Hanford, "With the Power of Soul," 32. "Frank Zappa (1940-1993) recalled that on one occasion when he was sitting in front of Hendrix's Marshall stacks at an Experience nightclub gig, he became 'physically ill' from the volume. 'And although it was great,' Zappa remembered, 'I couldn't see how anybody could inflict that kind of volume on himself, let alone [on] other people.'"

[99] Hanford I.I.I, "With the Power of Soul," 29-30.

[100] These are all colloquial terms and are not prominent in scientific literature.

by a myriad of factors. Therefore, "a player must, if attempting to create and design these sounds in live performance, make instantaneous analyses of feedback potential and be able to improvise alternatives when [harmonic] feedback cannot be induced, or, similarly, control it where it might unexpectedly be generated."[101]

Through masterfully navigating the high-volume relationships within his instrumentarium of electric guitar, effects pedals, and amplifier, Jimi Hendrix unlocked the sustaining capabilities of harmonic feedback, forever changing electric guitar playing. In this navigation, all guitarists are forced into an active relationship with their amplifier, transforming it into an instrument that both supports the sound of the guitar[102] and produces acoustic feedback through explicit interaction. Much like Bing Crosby, whose use of the microphone was assimilated into popular singing, harmonic feedback is now a standard part of electric guitar performance practice and can be expected to be heard in nearly every rock'n'roll setting. In contrast, microphonic feedback avoids systemization due to its indeterminate nature. This unpredictable quality is nevertheless explored and exploited in numerous process compositions of the classical avant-garde, of which Davies' *Quintet* is a seminal example.

From using feedback as a musical device, both Hendrix and Davies can be considered engaging with microphonic instrumentaria in which loudspeakers are employed in interactive ways that reveal their instrumental contributions to musical outcomes. Much like Crosby and Stockhausen, the adoption of Hendrix's and Davies' innovations mirror their positions within popular and avant-garde traditions. Through developing microphonic practices, Crosby and Hendrix changed the performance practice of their instruments in lasting, widespread ways, whereas Stockhausen and Davies created microphonic works that appear and sound novel to this day. Despite their differences, these four artists share a common legacy through the microphonic process, an understanding which is facilitated by equal consideration across genres. This perspective

---

[101] Hanford I.I.I., "The Power of Soul," 52.

[102] Guitarists also use amplifiers to "colour" their sound, sometimes vying for the "warmth" of vacuum-tube powered amplifiers. While the effect of an amplifier on the tone of an electric guitar is part of the microphonic process, it does not explicitly relate to new techniques, so it will not be discussed here.

continues in my analysis of two saxophonists who divergently employ the microphonic process in the 21st century.

4 The Microphonic Saxophone

The microphonic process, defined as the use of microphones and related media for musical ends, began with early microphone singers such as Bing Crosby, continued in popular music with electric guitarist Jimi Hendrix, and found a home in avant-garde classical music in the compositions of Karlheinz Stockhausen and Hugh Davies. While the work of these diverse artists is recognized by academics and has been integrated to varying degrees into contemporary musical practice, the microphonic process continues to evolve. In this chapter, I discuss two modern examples of artists who employ the microphonic process with the saxophone. The first is Canadian-American "avant-pop" saxophonist Colin Stetson (b.1975), who combines extended saxophone techniques with a multi-microphone setup to create complex solo performances. The second is free jazz[103] saxophonist John Butcher (b.1954), a prolific British improvisor who likely pioneered "feedback saxophone,"[104] an approach whereby acoustic feedback is induced and controlled by the tenor saxophone.

I discuss works of theirs that are indicative of their contributions to both saxophone performance practice and the microphonic process: *Judges* for Stetson and *streamers* for Butcher. In examining these works, I position Stetson and Butcher within the tradition of the microphonic process as I have described it. Despite being successful musicians in the 21st century, their work contradicts the close alignment between advancing technology and musical innovation – a trend that has only increased throughout the digital revolution. I conclude by addressing how Stetson and Butcher's work can be used as a model for meaningful alternatives to the increasing dominance of digital modes of production.

---

[103] While John Butcher and his creative peers would likely favour the term free improvisation, I use the term free jazz here to explicitly position this practice in distinction from popular and classical traditions.

[104] On various liner notes, Butcher describes this phenomenon as "feedback tenor" and "feedbacking" saxophone. I use "feedback saxophone" as the term in my own research-creation, which aligns with Butcher's work, hence its use here.

4.1 The Avant-Pop of Colin Stetson

Colin Stetson is a widely known, highly successful saxophonist, having released nine albums as soloist or band leader and nine full-length film soundtracks (as of April 2022).[105] Despite his success, little has been written about Stetson outside of brief interviews in popular sources. I first became aware of Stetson's work in 2011 when his breakout album *New History Warfare Vol. 2: Judges*[106] made the Polaris Music Prize shortlist.[107] Stetson's approach on the title track, *Judges*, is indicative of his work since then, whether solo, in ensembles, or on film scores. I will use *Vol. 2* to refer to the album to avoid confusion between the two.

Stetson's practice is easily identifiable through his use of large instruments, overtone playing, circular-breathing, and a noisy aesthetic. On *Judges* Stetson performs on a Bb bass saxophone, which sounds an octave below the Bb tenor saxophone. Its large keys, combined with the distance they travel, make the mechanical operation of the instrument much more percussive sounding than smaller saxophones. Like any large wind instrument, the bass saxophone gives easy access to upper partials in the harmonic series, making overtone playing relatively straightforward. Through air and embouchure manipulation, this technique allows players to access multiphonics (sounding multiple notes at once), as well as notes much higher than conventional fingerings typically produce. The ease to which overtones can be achieved on the bass saxophone allows Stetson to bring out many higher partials of the figures he is playing, sometimes sweeping fully into the upper notes of the harmonic series.

Circular breathing is a technique whereby breath is taken in through the nose while simultaneously being pushed into a wind instrument by way of the cheek muscles. Without

---

[105] His soundtrack work especially speaks to his commercial success, having composed for productions by Disney, National Geographic, and Legendary Pictures. To the extent that monthly listens on Spotify may indicate popularity, as of April 2022, Stetson surpasses jazz luminaries such as Chris Potter, as well as social media sensations Sam Greenfield and Chad Lefkowitz-Brown.

[106] Colin Stetson, *New History Warfare Vol 2: Judges*, Constellation, 2011, LP.

[107] This music prize "annually honours and rewards artists who produce Canadian music albums of distinction…without regard to musical genre or commercial popularity." From "About," Polaris Music Prize, accessed Sept 10, 2022, https://polarismusicprize.ca/about/.

needing to rest for conventional breaths when circular breathing, Stetson may play for long periods without stopping sound production, leaving no silence in *Judges*. Stetson does not use this technique to play long lyrical melodies, but instead uses it to fuel continuous arpeggiations and *ostinati*. Pitch bends and harmonic "chirps" resulting from embouchure changes while circular breathing can be heard throughout the piece.[108] Rather than attempt to execute the described techniques cleanly, Stetson embraces the entirety of sounds created by the saxophone's key percussion, his overtone playing, and circular breathing, to create a noisy musical aesthetic.

These techniques, however, are not solely the domain of Stetson – they have been used in jazz and contemporary classical music many years before him. Rather, Stetson's contributions come from his use of the microphonic process and combining these techniques with popular song structure. Using a series of conventional and contact microphones around and on the body of his instrument, he amplifies the percussive sound of his saxophone's keys to a level where it becomes primary musical material. Similarly, he uses a throat microphone,[109] to amplify vocalizations that he produces simultaneously while playing. The range of the bass saxophone is below most voices, allowing Stetson to hum or yell while playing with minimal interference.[110] Amplified vocalizations provide the lyrical melodies in *Judges* and the amplified mechanical sounds of the saxophone keys provides a percussive layer that would otherwise go unheard. What further distinguishes Stetson's work is that his virtuosic solo approach is structured within popular musical forms and phrasing. *Judges* is in a simple ABA form with four bar phrases where the primary melodic and harmonic content is repeating pentatonic figures and diatonic vocal melodies. Stetson summarizes his approach, "I'm playing solo saxophone with extended technique that, until now, has mainly been used in free jazz and improv. I'm using it in song

---

[108] Keeping an even tone while circular breathing is much harder on larger wind instruments, meaning the sounds described are common when circular breathing on bass saxophone.

[109] Early iterations of Stetson's throat mic may have been a simple contact mic strapped to his throat via an iPod armband. See Jeff Andrews, "Colin Stetson Makes You Forget Everything You Know About the Saxophone," *VICE*, May 5, 2017, https://www.vice.com/en/article/jpy89y/colin-stetson-makes-you-forget-everything-you-knew-about-the-saxophone.

[110] The closer a vocalized pitch is to a sounding note on a wind instrument, even at a consonant interval, the feeling of resistance increases as does the audible beat frequencies in the resultant sound.

form with rhythmic, repetitive and melodic music that's more akin to rock, classical and electronic."[111]

Much like the way Bing Crosby used the microphonic process to bring the warm, conversational tone of his singing to audiences, Stetson uses it to illuminate the intimate soundscape of the saxophone. Unlike Crosby, however, Stetson is not portraying a relatable aural image but creates a kaleidoscopic perspective normally only available to saxophonists themselves through their close contact with the instrument. Stetson relates this process to miking a drum set: "you can throw one overhead mic on it and get great recordings from that. However, you're going to get a very specific picture of the drum kit. Certain things won't be heard as well as other things. What I'm doing is the equivalent of putting a close mic on every drum, plus also miking things like the squeak of the bass drum pedal."[112] The vivid but unfamiliar portrayal of the saxophone that Stetson creates bears some resemblance to the psychedelic expansion of the electric guitar that Jimi Hendrix cultivated (see section 3.3). It should come as no surprise that Stetson grew up listening to the "futuristic and primal"[113] sounds of the guitar master,[114] as both artists combine the microphonic process with virtuosic and extended techniques to expand their instrument's performance practice. Stetson also shares his penchant for noise with Stockhausen, who loved the "glorious" scratching his step-filters made when they were pushed beyond their intended design (see section 3.1). Perhaps to assure listeners unfamiliar with such an approach to noise, *Vol. 2*'s liner notes state, "ALL NOISE AND DISTORTION ON THIS RECORDING IS INTENTIONAL[sic]".[115]

Unlike Stockhausen and Davies, who created microphonic pieces, Stetson follows in the footsteps of Crosby and Hendrix by creating a microphonic practice within popular forms.

---

[111] Benjamin Boles, "Colin Stetson," *NOW Magazine*, August 25, 2011, https://nowtoronto.com/colin-stetson.

[112] Boles, "Colin Stetson."

[113] Hanford I.I.I., "With the Power of Soul," 23.

[114] Herald, *The Advent*, 21.

[115] Stetson, *Judges*.

According to Christopher Herald, this places Stetson in the "post avant-garde" saxophone style, along with its pioneer, British free jazz saxophonist Evan Parker.[116] Stetson's and Parker's music share some similarities regarding extended saxophone techniques and circular breathing, but Herald does not address how drastically pop forms and his use of microphones differentiates Stetson from his contemporaries. Using the microphonic process, Stetson transforms relatively simple melodic and harmonic language into dense, polyrhythmic and polyphonic solo works that evoke a heavy metal band more than they do his free jazz saxophone forebears. Moreover, Stetson's unique approach has not just innovated within established genres, it instead has created a unique style of saxophone playing in what could be considered a new genre of instrumental avant-pop.

4.2 John Butcher and Feedback Saxophone

John Butcher is a British saxophonist who began seriously improvising in the 1980s after leaving an academic career in physics. He has recorded 74 albums as soloist or leader; five with the ensemble Polwechsel; and 23 with other ensembles.[117] According to musician and author David Toop:

> There is an established tradition of solo improvisation, a kind of public research through which the vulnerability of the instrumentalist is exposed, his or her skill simultaneously undermined by the naked air yet reinforced by being laid bare, as if to say, this is what exists in all its eloquence in isolation. John Butcher is exemplary within this tradition, of course, yet through the nature of his playing, lyrical even in extremis, brings to mind unaccompanied solos by reed players from a very different time…Whereas jazz is a form of dynamic counterpoint, such solos seem closer to torchlit lines extended into darkness. They impose and stretch their own limits, within which the line remains identifiably a line. In John Butcher's case, the line is not so much taken for a walk as fuzzed, scuffed, smudged, multiplied or expanded to probe the space through which it cuts.[118]

Despite Butcher's prolific contributions to saxophone improvisation and performance practice, little has been written about him in academic sources. For this analysis therefore, I draw from a

---

[116] Herald, *The Advent*, 9.

[117] "John Butcher," Wikipedia, Accessed May 4, 2022, https://en.wikipedia.org/wiki/John_Butcher_(musician).

[118] John Butcher, *Invisible Ear*, Bandcamp, Weight of Wax, 2003.

personal conversation I had with him. Much could be said about Butcher's improvisation practice, but this discussion focuses on his use of the microphonic process in "feedback saxophone." Feedback saxophone is only seriously practiced by a handful of professional artists[119] and could be described as an instrument, a technique, or an approach. At its core are the interactions between a microphone, loudspeaker, and space, all mediated by the saxophone to induce and control acoustic feedback.

Butcher uses two approaches to feedback saxophone. The first involves a microphone on a stand, which I refer to as the "freestanding" approach,[120] while the second involves a microphone fixed to or inside the bell of the instrument, which I refer to as the "fixed" approach.[121] In the freestanding approach, the positions of the microphone and loudspeaker relative to each other are static, as are their settings. Butcher consequently controls the feedback by means of changing the distance between himself and the microphone – even without the saxophone, the mere presence of a body in a space affects the resonant frequencies within the system. When Butcher intentionally engulfs the microphone with his instrument's bell, moving the keys impacts the resonant frequencies and allows him to control the feedback tones. In the fixed approach, a small microphone, sometimes referred to as a "lapel mic," is placed inside the bell of the saxophone. In this case, the distance between the microphone and the saxophone is static, whereas the distance between the amplified saxophone and loudspeaker can be manipulated. The positioning of microphone here gives Butcher immediate access to "keyed" feedback pitches, provided that an appropriate volume/distance relationship relative to the speaker is maintained. To facilitate this relationship, Butcher uses a volume pedal to control the signal sent from the microphone to the loudspeaker and shape the feedback tone.

---

[119] John Butcher, Graham Halliwell, and Michael Fischer are the only serious feedback saxophone practitioners I have encountered besides myself.

[120] edgare, "John Butcher at All Tomorrow's Parties," YouTube, Dec 12, 2010, https://youtu.be/uCjrN8ZuIqM.

[121] Michael C. Fischer, "Michael Fischer, feedback-saxophone, Vienna 2018," YouTube, April 9, 2019, https://youtu.be/JTRkuAcFsWw. I could not find any footage of Butcher using the fixed approach.

Butcher's *streamers*[122] is representative of his feedback saxophone practice that comes from the free jazz tradition, in that it does not adhere to forms related to traditional jazz or classical idioms, and does not centre on harmonic rhythm or conventional phrase structure. Instead, Butcher's feedback works focus on timbral and rhythmic development in free forms or forms that are not obvious lacking detailed analysis. One could not conceive of a structural approach more contrasting to Stetson's. *streamers* is consistent with much of Butcher's feedback work in that he does not combine the feedback tones with the saxophone's conventional sound.

In this improvisation, Butcher develops two sound sources using the fixed approach to feedback saxophone: amplified key percussion and acoustic feedback. Due to the incredibly sparse nature of this work, the key percussion is far more exposed than in Stetson's work, revealing two distinct sounds, a slightly pitched thud when a key is depressed, and a knock, occasionally accompanied by a rattle, when a key is released. The feedback tones change as Butcher manipulates the keys, with what sounds to be a direct key-to-feedback relationship. Occasionally, there are moments when no key sound is heard, yet the feedback tone changes. This could be due to Butcher changing the distance between the saxophone and the loudspeaker, or by slight key pressure changes that are inaudible yet still impact the feedback pitch. Likewise, there is dynamic movement in the feedback, which may be caused by changing position and/or by the additive nature of the feedback itself – it can get louder as it sustains. The occasional volume swell, to decrescendo, to silence, without significant pitch bending suggests that Butcher is using a volume pedal, which is consistent with his fixed approach.

Butcher's work shares various connections with his microphonic predecessors. Like Hendrix, he uses an instrument to mediate feedback as a way of extending his instrument's expressive capabilities. Where Hendrix used the microphonic process to combine feedback into his already loud, visceral performance style, Butcher instead uses the microphonic process so that he may strip down the saxophone to create a much more fragile aesthetic. In this sense, Butcher uses the microphonic process to portray an intimate image of the saxophone, what Bing Crosby may have sounded like had he engaged in free jazz crooning. Most important is the connection between

---

[122] Butcher, *Invisible Ear*, track 4.

Butcher's work and Davies' *Quintet*. While they both employ space as part of their microphonic instrumentaria, a story from Butcher points to fundamental differences between them.

At the Huddersfield Contemporary Music Festival[123] in 2019, Butcher spent a considerable amount of time preparing a feedback saxophone improvisation in the multi-speaker venue where the performance was to take place.[124] While he prepared, he was the only person in the space, but during the night of the concert the venue was filled by an audience dressed in their heavy winter coats. The new presence of many dense, sound-absorbing materials and bodies drastically altered the acoustic properties of the space and eliminated many of the resonant frequencies Butcher had been working with, forcing him to perform in a far different manner. If Huddersfield is indicative of Butcher's broader practice, the recording of *streamers* likely was made in the same way: with some preparation but ultimately freely interacting with the resonant frequencies of the time and place. In comparison with Butcher's work, *Quintet*'s performers are bound to follow the instructions in the score and therefore are more limited when it comes to interacting with the space. In this sense Butcher employs space as an active musical component in his microphonic instrumentarium, whereas space plays a more passive, supportive role in *Quintet.*

4.3 Post-Digitalism and Minimally Augmented Instruments

The microphonic instrumentaria employed by Crosby, Stockhausen, Davies, and Hendrix, were made up of cutting-edge technologies. While Stetson and Butcher continue the lineage of the microphonic process in 2023, their novel approaches are facilitated by rudimentary devices that their microphonic forebears would have recognized and understood. Technological development has greatly accelerated in recent decades, so why does Stetson's and Butcher's work break the long-standing relationship between advancing technology and musical practice? These two saxophonists are engaged in post-digitalism, a movement that has emerged in reaction to the

---

[123] An annual international music festival held at the University of Huddersfield, in Huddersfield, West Yorkshire, England.

[124] "Solos and plurals: the improvisation of John Butcher," Huddersfield Contemporary Music Festival, Accessed April 17, 2020, https://hcmf.co.uk/solos-and-plurals-the-improvisation-of-john-butcher/.

growing prevalence of digital media in the 21st century. To explain this, I discuss some of the musical-technological developments of the late 20th and early 21st century.

In *Any Sound You Can Imagine: Making Music / Consuming Technology*,[125] Paul Théberge explains how the relationship between musicians and technology evolved over the latter part of the 20th century. He notes that during the 1960s and early 70s, new technological innovations were taken up by artists to create a diversity of musical experiences, including Hendrix's distorted feedback, The Beatles' elaborate multitrack studio albums, and Stevie Wonder's Moog synthesizer basslines.[126] He refers to this technique-centred musical-technological relationship, which includes the discussed microphonic innovators, as the "sound" paradigm. Dominating until the digital revolution, at least in popular music, in the style paradigm a genre's conventions are challenged and innovated through new techniques in "performance, recording, and/or original programming."[127] However, as digital software and instruments became more widely adopted by pop artists, the musicians became enmeshed in a consumerist relationship with their musical tools, both driving, and being driven by, the market forces that produced them. Focusing on pop artists in the 80s and 90s, Théberge describes this new relationship as one characterized by the paradigm of "sound." In this paradigm, artists do not pursue innovation through new techniques, but instead seek the "acquisition and technical modification of pre-existing sounds"[128] which are housed in a variety of physical and virtual digital instruments, such as samplers, drum machines, and synthesizers.

The distinction between the style and sound paradigms is useful, in that it separates two fundamental approaches to music performance. At the core of the style paradigm is how artists employ a technical approach towards their instrumentarium. Hendrix, for example, used his

---

[125] Paul Théberge, *Any Sound You Can Imagine: Making Music / Consuming Technology* (Hanover: Wesleyan University Press, 1997).

[126] Théberge, *Any Sound*, 1.

[127] Théberge, *Any Sound*, 191.

[128] Théberge, *Any Sound*, 187.

amplifier as part of the microphonic process to develop new techniques for electric guitar, expanding the sounds it could produce through distinct and explicit interactions. In contrast to Hendrix, what Théberge suggests is that popular guitarists who engage in the sound paradigm are more likely to incorporate new musical materials by buying them, rather than develop them through technical means. This plays out in popular electric guitar practice today where it is common for electric guitarists to own a plethora of effects pedals that are not intended to fundamentally change their playing technique, but nevertheless gives them access to sought-after sounds.

For classical music, however, moving towards the sound paradigm did not mean shifting away from novel recording methods or original programming. The growing relevance of coding in Max, a visual programming language for music, and the continued importance of sophisticated electronic music studios housed in universities, signal that new approaches to production are still valued. Yet, like in pop music, computer music performance of the 1990s and early 2000s emphasized these programming and production methods over live performance and instrumental technique, leading scholars to criticize the increasing presence of "knob twiddling" and electronic "baby-sitting" in the genre.[129] Julio d'Escriván questioned the lack of visible effort in electronic music performance of the time, suggesting, "It seems that the newer the technology applied to music, the less effort is apparent on the part of the performer."[130] Such a statement mirrors van Eck's instrumental frameworks: without visible performer effort, which often relates to explicit interactions with an instrument, it is difficult to perceive the instrumental qualities of digital devices. To address the shortcomings of the seemingly effortless and transparent qualities of the sound paradigm, "interactive" computer music intended to recentre human performers in what could be considered an updated style paradigm within classical electronic music. Unsurprisingly, Guy Garnett suggests that including human performers in a work allows for more gestural nuance, varied interpretations, and an extended performance life, when compared

---

[129] W. Andrew Schloss, "Using Contemporary Technology in Live Performance: The Dilemma of the Performer," *Journal of New Music Research* 32, no. 3 (2003): 240.

[130] Julio d'Escriván, "To Sing the Body Electric: Instruments and Effort in the Performance of Electronic Music," *Contemporary Music Review* 25, no. 1-2 (2006): 183.

to purely electronic works.[131] He also believed that "the use of the computer conjoined with a human performer brings with it the possibility for certain new extensions to performance brought about by the technology itself,"[132] while also extending "the performer's ability based on skills the performer already has."[133]

One outcome of this desire for a more balanced human-technological relationship was the development of augmented instruments – acoustic instruments equipped with electronic media such as MIDI controllers, microphones, and finger-pressure sensors. Augmented instruments most frequently interface with digital software run by an external computer that controls any number of musical parameters and events, such as modifying the instrument's signal, triggering pre-recorded sounds, and even generating visual material. There have been numerous augmented instruments developed, but augmented wind instruments are the most pertinent to this discussion. The accelerating power and availability of computer software along with decreased costs of fabrication and design leads many augmented instruments to have a maximal approach to electronic additions. For example, the "hyper-flute" developed by Cléo Palacio-Quintin has the following augmentations: an ultrasound sensor, two magnetic field sensors, an accelerometer, three pressure sensors, six buttons, a light sensor, and a gyroscope.[134] Similarly, Matthew Burtner used the 15 sensors on his "metasaxophone" to create MIDI data that controlled nearly two dozen parameters on a software-based virtual violin.[135] Augmented instruments such as the hyper flute and metasaxophone are examples of digital technology being used to expand woodwind performance practice. Palacio-Quintin herself, however, recognizes their limitations:

---

[131] Guy E. Garnett, "The Aesthetics of Interactive Computer Music." *Computer Music Journal* 25, no. 1 (2001): 21-33.

[132] Garnett, "Aesthetics," 25.

[133] Garnett, "Aesthetics," 31.

[134] Cléo Palacio-Quintin, « Composition d'oeuvres pour hypre-flûtes et traitement audionumérique interactif » (DM thesis, Université de Montréal, 2011), 29- 30.

[135] Matthew Burtner, "The Metasaxophone: Concept, Implementation, and Mapping Strategies for a New Computer Music Instrument," *Organised Sound* 7, no. 2 (2002): 201-213.

> there are very few performers who have played consistently on the same augmented instrument for as many years as I have, and there have been almost no publications concerning performance skills on such new instruments…The instruments themselves have not changed much (the hardware is mainly the same), even if the software developed to play with them evolves with each new work. This long-term dedication to interactive performance on stable interfaces gave me the opportunity to develop a real professional practice. Such a level of virtuosity – like any professional instrumentalist would have on an acoustic instrument – is unfortunately rarely achieved on new interfaces, due both to a lack of dedication over time, and to changes in technology that make interfaces obsolete before even being mastered by any performer.[136]

This statement points to why augmented instruments have not made a lasting impact on instrumental performance practice. Augmented instruments may have helped refocus human performers in electroacoustic classical music, perhaps nearing a balance between the style and sound paradigms, yet software remains the most potent part of the instrument. Augmented instruments rarely produce performances that convincingly combine the acoustic qualities of the "base" instrument with digital extensions, as the acoustic instrumental technique is frequently overshadowed and overpowered by the software it is purportedly controlling. Furthermore, traces of the consumerist sound paradigm present in augmented instruments means that by the time a particular instrument has been fully developed, the electronic sounds it is controlling are no longer fashionable.

The power balance between electronic and acoustic sound, rapidly changing technology, heightened complexity, and other negative impacts of the sound paradigm, are all reasons to question the merits of the digital revolution for music performance. Various schools of thought have spung up to address the shortcomings of, and provide meaningful alternatives to, digital hegemony. D.I.Y. electronic musician and theorist John Richards explains how many are dissatisfied with "the vestiges of the digital world: the virtual, wireless, pseudo-modernist design, utilitarianism and seemingly endless possibilities." This critique, Richards continues, "is

---

[136] Cléo Palacio-Quintin, "2008: Eight Years of Practice on the Hyper-Flute: Technological and Musical Perspectives," in *A NIME Reader Current Research in Systematic Musicology*, vol. 3, eds. A.R Jensenius and M.J. Lyons (Springer, Cham, 2017), 347.

not born of nostalgia nor an attempt to re-create the past but is a way of trying to dislodge the ubiquity of digital technology."[137]

These sentiments and desires are manifested in post-digitalism, a movement or aesthetic which involves "an approach to creative work that embraces technologies, be they digital or analogue, software or hardware – including their faults" and whereby the "accidental, the outcast, the 'noise' of machines and the 'idiosyncrasy' of software processes are brought to the centre of creative practice."[138] Unlike the consumerist sound paradigm whereby new material is ready-made for purchase, post-digitalism brings into focus the limitations and particularities of technology, including acoustic musical instruments. The failure of augmented instruments to impact instrumental practice is a result of their reliance on digital modes of production which do not convincingly integrate these idiosyncrasies.

Could post-digital augmented instruments accomplish this integration? "Infra-instruments," as proposed by John Bowers and Phil Archer, is one model that does. These are augmented instruments in line with post-digital thinking that are "of restricted interactive potential, with little sensor enhancement, which engender simple musics with scarce opportunity for conventional virtuosity."[139] One of their examples is the "strandline guitar" whereby the pickup, strings, and whammy bar of a guitar are removed from the body and affixed with, and to, various beach detritus.[140] Such instruments certainly provide a model for post-digital augmentation but do little to further conventional instrumental practice. How then can post-digitalism be used as a core aesthetic in augmented instruments that may also engage in and even advance instrumental technique?

---

[137] John Richards, "Getting the Hands Dirty," *Leonardo Music Journal* 18 (2008): 26.

[138] John R. Ferguson, and Andrew R. Brown, "Fostering a Post-Digital Avant-Garde: Research Led Teaching of Music Technology," *Organised Sound* 21, no. 2 (2016): 127-128.

[139] John Bowers and Phil Archer, "Not Hyper, Not Meta, Not Cyber but Infra-Instruments," in *Proceedings of the 2005 International Conference on New Interfaces for Musical Expression*, (2005): 5.

[140] Bowers and Archer, *Infra-Instruments*, 7.

I propose minimally augmented instruments as a model for integrating the technique-centred style paradigm with the guiding principles of post-digitalism. Exchanging the term instrumentarium for augmented instrument, forerunners of the microphonic process such as Crosby and Hendrix become pioneers of augmented instruments as well. Naturally, pre-digital artists could not have engaged with post-digitalism, so Stetson and Butcher become the exemplars. Stetson makes his post-digital attitudes explicit in his liner notes concerning his intentional use of noise (as explained above) and by bringing attention to his live performance virtuosity: "all songs recorded live in single takes with no overdubs or loops."[141] Similarly, for a time Butcher used a laptop to control his feedback but stopped because it "made it seem more complex than it really was."[142]

Through minimally augmenting their instruments using the microphonic process, Stetson and Butcher harness the noise of their instrumentaria, be it key percussion or acoustic feedback, which they mediate through distinct instrumental techniques. The minimal augmentations and instrumental primacy of their practices combat the consumerist tendencies inherent in the sound paradigm, future-proofing their instrumentaria from obsolescence and ensuring their equipment can be easily found, repurposed, and repaired. As their musical grammar stem from their physical instrumentaria, no digital sounds may overshadow their instrumental technique, and they, as human performers effortfully interacting with augmented instruments, remain at the centre of the music. To expand on their work and contribute to post-digitalism and the concept of the minimally augmented instrument, I now present my work with the microphonic process in an original approach to feedback saxophone.

---

[141] Stetson, *Vol. 2*.

[142] Personal conversation with the author, 2022.

5 Research-Creation in Feedback Saxophone

In this final chapter, I describe my research in feedback saxophone. Likely pioneered by British free jazz saxophonist John Butcher, a feedback saxophone system is at minimum composed of a saxophone, microphone, and amplified loudspeaker. Through the web of interactions between this collection of musical tools and the space they are in, what I refer to as an instrumentarium, acoustic feedback is induced and controlled by the performer using the saxophone. Feedback saxophone is a modern iteration of the microphonic process, a musical approach that began with the early microphone singers of the 1920s (see Chapter 2), whereby microphonic instrumentaria are used to innovate musical practice.

The works I discuss are three concert etudes for my feedback saxophone system, *Stride*, *Doina*, and *Yen*, the creation of which is described using Sandeep Bhagwati's cyclical AGNI method. In Chapter 1, I illustrate my "problem-practice-exegesis" research-creation methodology, of which AGNI is a part of. AGNI stands for Analysis, Grammar, Notation, Implementation. It is a cyclical process that spins into iterations of itself and as such, may begin at any step in the cycle. While AGNI plays out differently in these three pieces, the steps of the process generally proceed as follows. I begin with analyzing (A) an electroacoustic saxophone work or works, whether feedback or otherwise, to identify shortcomings, interesting approaches, equipment, or musical gestures. Upon choosing a musical foundation from (A), the following step is grammar (G), where I develop and/or expand the musical vocabulary of my system through improvisation. Next, the new vocabulary is organized and notated (N) in rough sections, then performed as a structured improvisation, which eventually develops into a more static composition. The implementation (I) is complete when the score is finished, and the performance has been recorded in audio-visual formats. A single score and performance, however, do not provide comprehensive results – the empirical research process must begin anew for deeper answers. Accordingly, I critically analyze (A) the completed work and ask, "how can this be expanded or improved?" The results of this inquiry are applied to develop grammar (G) for another piece, and so on (N, I, A, etc.).

After describing this research, I critically reflect on the process and products of it. In this discussion, I position my work in feedback saxophone within the tradition of the microphonic

process, then relate it to the work of John Butcher, as well as Colin Stetson (see Chapter 4) – another present-day microphonic saxophonist. Through these descriptions and analyses, I document the rare practice of feedback saxophone and demonstrate the importance of post-digitalism and the style paradigm in 21st century electroacoustic music.

5.1 Etude No. 1 – *Stride*

5.1.1 Grammar

I discovered saxophone-controlled feedback in 2015, in my hometown of St. John's, Newfoundland and Labrador, Canada when I was performing in an ad-hoc group at "Night Music," a monthly free-improv jam hosted by the renowned Sound Symposium festival. I had positioned my saxophone close to a microphone and when I lifted the bell of my instrument to cover the microphone, a sine-wave-like feedback tone[143] emerged from the stage monitor.[144] Upon hearing this effect, I tried to recreate it and, by intent or chance, I moved a key and changed the pitch of the feedback tone. Despite this being a completely novel phenomenon to myself, the other musicians, and the audience, I was chastised by the sound technician[145] – these sustained tones were not good for the equipment – so I treated this phenomenon as interesting but left it for a later time.

In the first week of my doctoral studies at the University of Toronto in September 2018, I was asked to perform at a Faculty of Music event for incoming graduate students. I agreed to do so and decided that this would be the opportunity to finally explore the feedback phenomenon I had encountered years prior. I had never heard it outside of my own chance encounter at Night Music, so there was no material that I could analyze or draw from – I was not even sure how I would recreate it. I therefore had to begin with the grammar step in the AGNI process. To develop the musical grammar of this imagined feedback saxophone system however, I had to first assemble my microphonic instrumentarium. To do so, I engaged in "comprovisation," a

[143] Similar to when someone cups a live microphone with their hand.

[144] A stage monitor is a loudspeaker placed on stage facing the performer so that they may hear themselves.

[145] Wallace Hammond.

method that has been a vital component throughout the history of the microphonic process which combines improvising with the composing, or assembly, of an electroacoustic instrumentarium.

According to Richard Dudas, there are "two basic species of composition-improvisation relationships intrinsic in working with electronic and computer music: (1) composing an "instrument" that can be improvised upon in performance, and (2) improvising with tools in order to create pre-compositional material."[146] Dudas uses quotes to signify that the "instrument" is an assemblage of digital software, physical electronic devices, acoustic instruments, and more – in other words an instrumentarium. This composed instrumentarium results from the processes of trial and error, of improvising with equipment, signal chains, positioning, and performance techniques. Through and on the instrumentarium, expressive musical grammar can be developed using further improvisation, trial, and error. Using this approach, I composed the first iteration of my feedback saxophone system and while equipment is not grammar, my instrumentarium is the means through which grammar can be discovered and developed, which is why the comprovisation process is included in the grammar sections of this discussion.

In assembling the instrumentarium that became my initial feedback saxophone system, I experimented with a Shure Beta 57 instrument microphone,[147] an ART pre-amplifier,[148] and a Yorkville 50KW amplified loudspeaker.[149] Figure 5-1 shows the signal chain for this early iteration of my instrumentarium. Attempts to induce feedback with the microphone on a stand did not yield reliable results, so I therefore placed the microphone directly into the bell of my tenor saxophone, as pairing the microphone with the alto saxophone did not work (likely due to the insufficient size of the bell). I adjusted the volume on the pre-amp, dampened the high and

---

[146] Richard Dudas, ""Comprovisation": The Various Facets of Composed Improvisation within Interactive Performance Systems," *Leonardo Music Journal*, 20 (2010): 29-31.

[147] "Beta 57A," Shure Products, Accessed April 13, 2023, https://www.shure.com/en-US/products/microphones/beta_57a?variant=Beta%252057A.

[148] "USB Dual Pre Project Series," ART Pro Audio, Accessed April 13, 2023, https://artproaudio.com/product/usb-dual-pre-project-series-two-ch-usb-pre/.

[149] "Yorkville Compact Powered Monitor / Instrument Amplifier – 50 Watts," Long & McQuade, Accessed April 13, 2023, https://www.long-mcquade.com/358/Pro-Audio---Recording/PA-Speaker-Cabinets/Yorkville-Sound/Compact-Powered-Monitor---Instrument-Amplifier---50-Watts.htm. Hereto referred as the amplifier.

boosted the low frequencies on the amplifier equalization knobs, and positioned myself directly in front of the amplifier. This setup allowed me to consistently produce a collection of feedback tones that I could manipulate with the keys of the saxophone without blowing into the instrument.

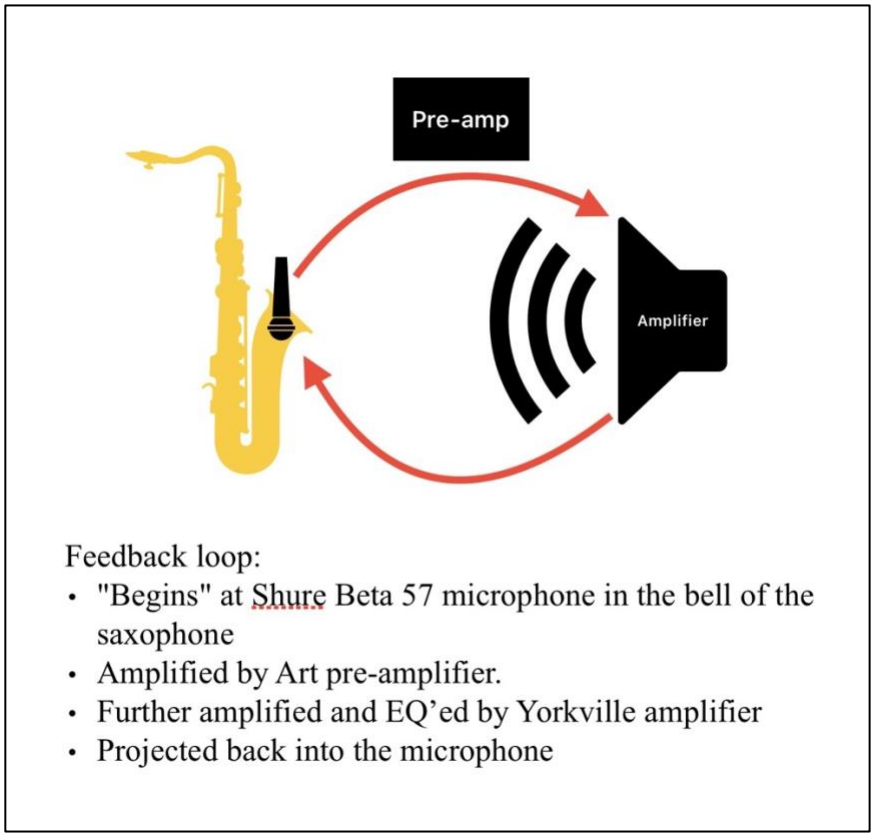


Figure 5-1: Feedback saxophone signal chain.

5.1.2 Notation

Figure 5-2 shows an early sketch of some of the feedback gestures I had discovered. They are written according to the first iteration of my notation approach, a two-staff system similar to the notation used in woodwind scoring for "fundamental" fingerings and available overtones. In my notation, one staff shows the required fingering (using the European or "Londeix" system),[150] while the other displays the resultant feedback pitch. In this case the fundamental B ♭ fingering

[150] See Appendix 4.

with additional or subtracted keys is in the top staff, while the resulting feedback pitch is in the bottom staff.

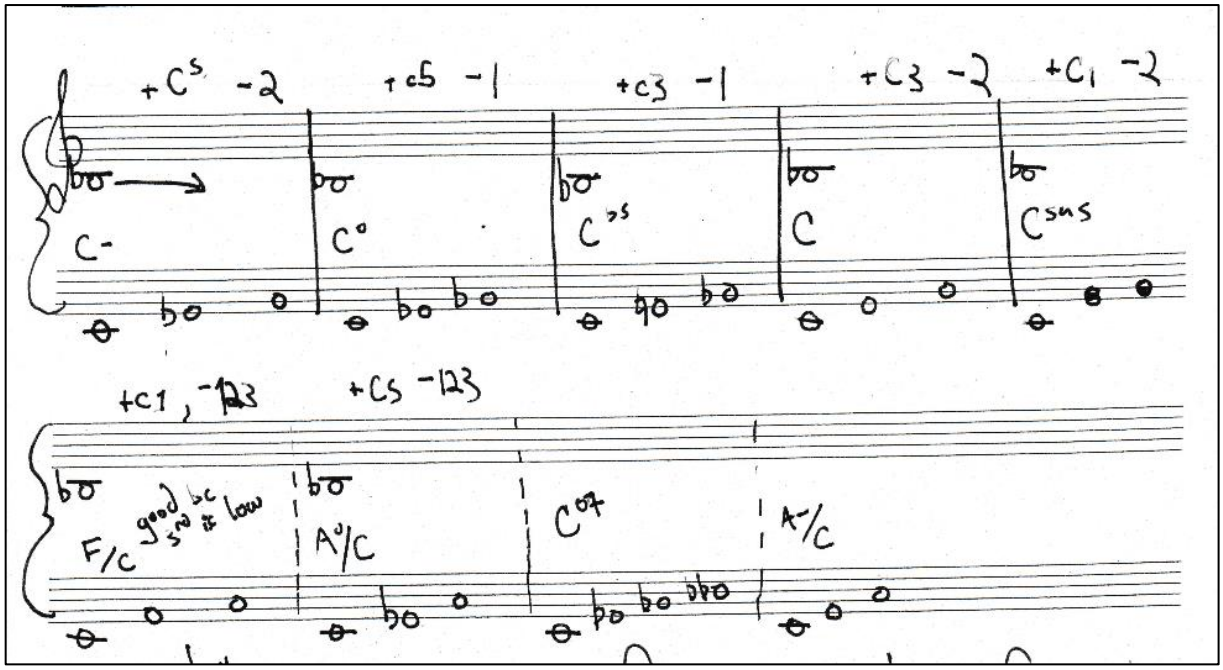


Figure 5-2: Feedback gestures (bottom staff) based off a fundamental fingering (top staff). [151]

Figure 5-3 shows the pitches I chose for *Stride*, notated in a similar style but with the staves switched. The fundamental fingerings of B ♭ and B in this collection produce feedback pitches a tone higher – C and D ♭ – than what would be conventionally produced through blowing but maintain the same semitone relationship. This semitone relationship continues even as keys are similarly added or subtracted from each fundamental fingering. Two additional pitches are made by dampening the reed, notated as "DR," achieved by pressing the tongue or lower lip against the reed to create a seal against the mouthpiece. These notes form a hexatonic scale that resembles the *freygish* or *hijaz* mode used in much Jewish and Arabic music, with the bottom two notes acting as approach notes to the lower tonic (C). Additionally, the C (C E G) and D ♭ (D ♭ F A ♭) major triads present in this scale are prominent figures in the piece.

[151] My notation is transposed in Bb, up a major 9th, the same as tenor saxophone.

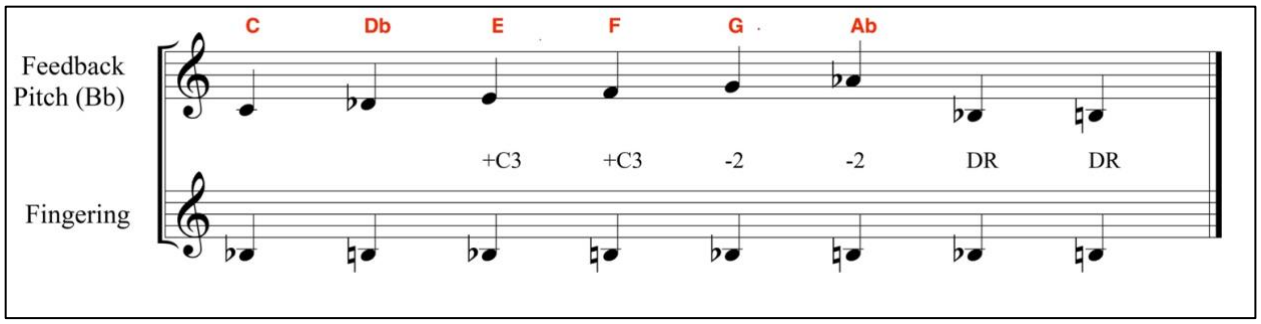


Figure 5-3: Scale for *Stride*.

I recorded improvisations using the above material that I reviewed to note successes, new discoveries, and areas to improve. Through this process, I developed the melodic material, which I then organized into cells to ensure improvisation remained part of the interpretation process (fig. 5-4). To create a work that clearly demonstrated the basic functions of my feedback saxophone system, I limited the piece to the above notes and constrained its harmonic and formal complexity. It follows a simple three-part musical structure over five rehearsal letters, is pulse-driven, with rising triads in compound time as the primary source material.[152]

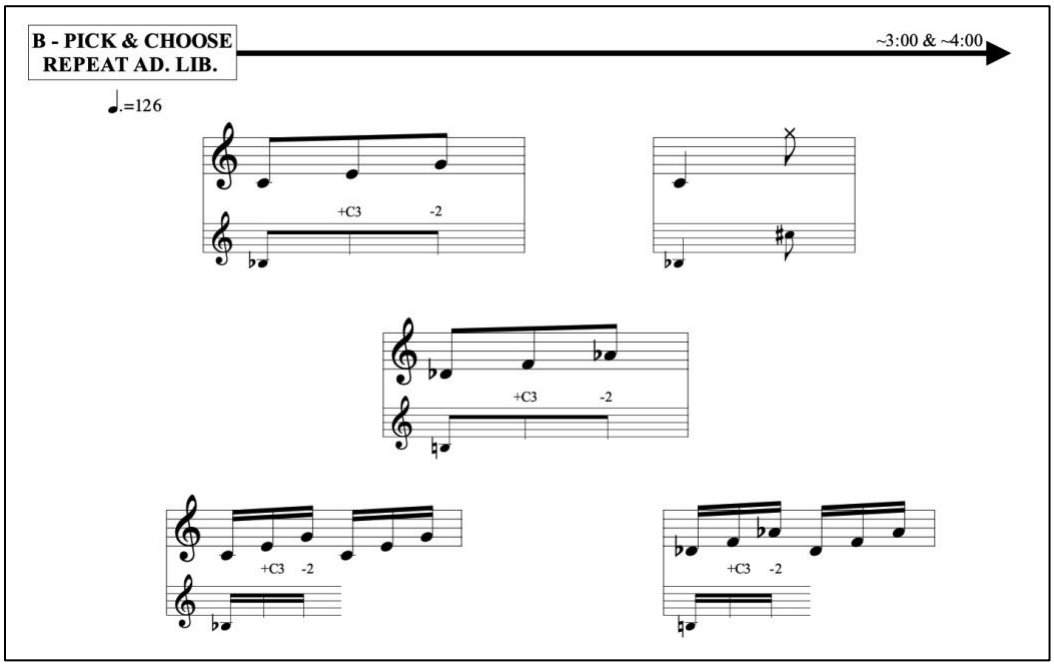


Figure 5-4: Melodic cells from *Stride*.

[152] This main material evoked a broad, brisk walk, hence the name, *Stride*.

5.1.3 Implementation

To complete the first cycle of AGNI, this research was implemented (I) as a score and recording. As I discuss in Chapter 1, this type of research-creation is only complete as both exegesis and creative artefact, and is not meant to be understood fully as either/or. The recording can be viewed by clicking below (linked through fig. 5-5) and the score is in Appendix 1. The recording and score represent an advanced version of the work that was modified with the newer equipment and techniques I discovered as I created the next piece. When I began working with feedback saxophone, it was not clear it would become the focus of my research, so audio-visual documentation from the very early days is non-existent. While I believe *Stride* captures the intent and most useful discoveries of this initial foray, early documentation would provide a deeper understanding of this research and would reveal if there were discoveries I have failed to pursue.

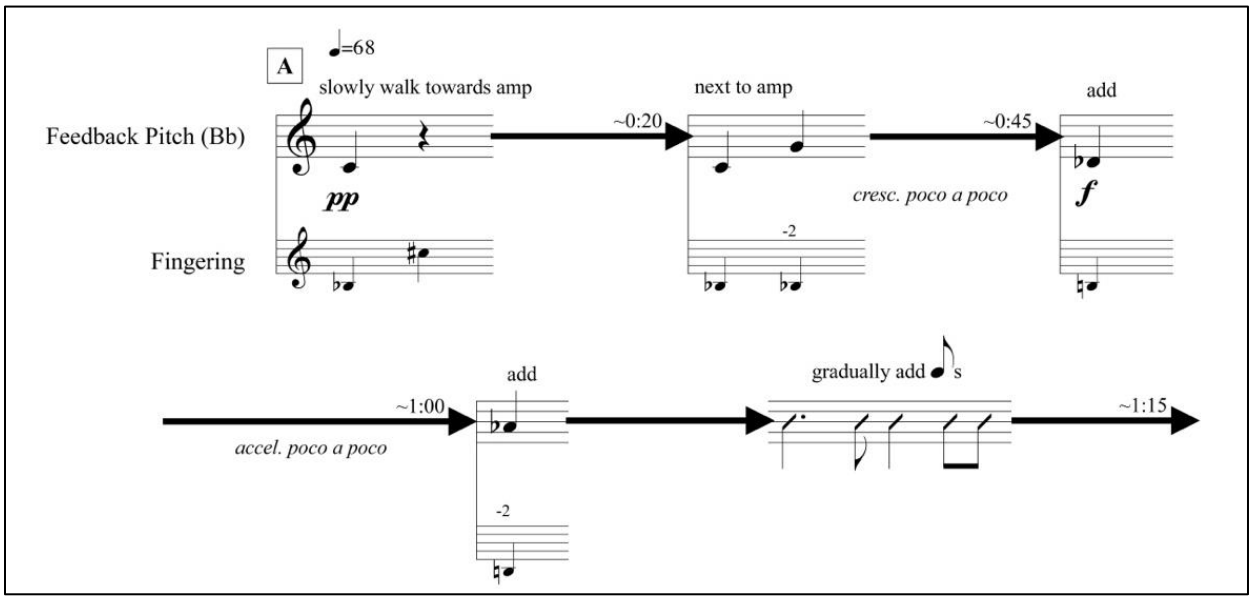


Figure 5-5: Video link for *Stride*.

5.2 Etude No. 2 – *Doina*

5.2.1 Analysis

I began the AGNI cycle anew to write a second piece that expanded and improved my feedback saxophone system thus far. *Stride* was limited in and by its equipment, musical language, and notation. Placing the Beta 57 microphone in the saxophone occasionally scratched the inside of the bell and prevented the bottom three conventional notes from sounding correctly, a limitation that contributed to the work not using conventional sound. While developing the piece, there

were several instances of piercing feedback, both when I was working alone and when I was presenting my research – an unsustainable and dangerous hazard. Whereas *Stride* had only employed feedback gestures on their own, I was curious if and how feedback tones could be combined with conventional playing. The notation in *Stride* was also limited by its two-staff system, which was useful for documenting initial findings, but cumbersome for denser music.

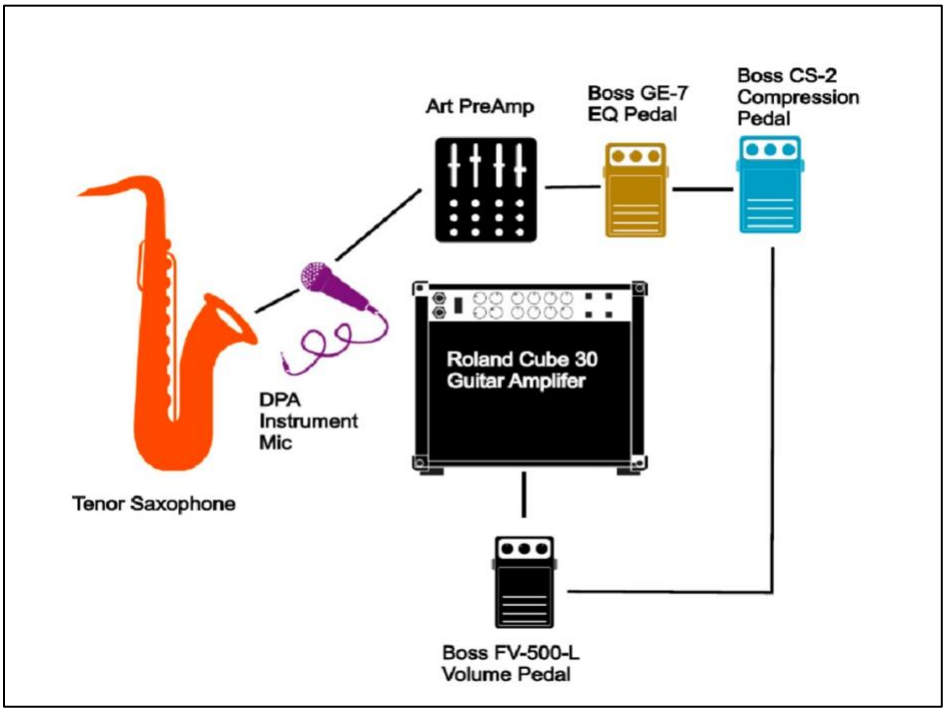


Figure 5-6: Signal chain diagram for *Doina*.

5.2.2 Grammar

To address the limiting factors of the Beta 57, I began using a small "lapel" microphone, the DPA 4060,[153] which facilitated the feedback notes I had discovered, was lighter and never scratched the saxophone, and did not encumber the regular playing of the instrument. To avoid feedback experiences that could be harmful to the ears, I added a Boss CS-3 compression pedal[154] that amplified soft sounds while limiting loud ones. Not only did the compression pedal

[153] "4060 Series Miniature Omnidirectional Microphone," DPA Microphones, Accessed April 13, 2023, https://www.dpamicrophones.com/lavalier/4060-series-miniature-omnidirectional-microphone.

[154] "CS-3 Compression Sustainer," BOSS, Accessed April 13, 2023, https://www.boss.info/global/products/cs-3/.

make this research safer for my audiences and I, but its tone knob enabled a wider variety of feedback notes. Similarly, I added a Boss FV-500L volume pedal[155] that allowed me to quickly mute and dynamically shape the feedback tones, as seen and heard in the scores and recordings. Adding a Boss GE-7 equalization pedal[156] enabled the tuning of specific feedback pitches. I also discovered that the much smaller Roland COSM Cube 30[157] amplifier worked with this updated instrumentarium while also providing a broader spectrum of timbres. Figure 5-6 depicts this new instrumentarium and its signal flow.

I chose to maintain the relatively transparent musical aesthetic of the first piece, as I was adding a completely new technique: combining conventional playing with feedback to create harmony. The nature of the low Larsen tones used in *Stride* meant that it was difficult to combine acoustic playing with them. The feedback tones I consequently used for this second piece were an octave and a half above the pitches in *Stride* and, rather than appear as standalone melodic shapes moving through a scale, they were clustered close together to act as drones around which conventional notes could travel. Figure 5-7 shows some melodies surrounding a single feedback note, in addition to figures involving conventional and feedback pitches moving together. In Klezmer and Balkan music, the *doina* is a free-form, highly ornamented improvised tune. Having played much of these musics as a professional, I felt *Doina* to be an appropriate name for this second etude considering the musical grammar I had devised.

5.2.3 Notation

The new feedback notes in *Doina* no longer could be thought of or notated as being related to a fundamental pitch or fingering. I therefore devised a single-staff system in which feedback tones were represented by diamond noteheads, making the notation more in line with conventional contemporary saxophone scoring and easier to read. Figure 5-8 shows a sketch I had made for the form of *Doina* that I used like a "chord changes" jazz chart to improvise over. I recorded

---

[155] "FV-500H/FV-500L," BOSS, Accessed April 13, 2023, https://www.boss.info/global/products/fv-500h_500l/.

[156] "GE-7 Graphic Equalizer," BOSS, Accessed April 13, 2023, https://www.boss.info/global/products/ge-7/.

[157] "CUBE 30 Guitar Amplifier," Roland, Accessed April 13, 2023, https://www.roland.com/us/products/cube_30/.

myself playing this form many times while noting how I could continue to shape the piece before recording it.

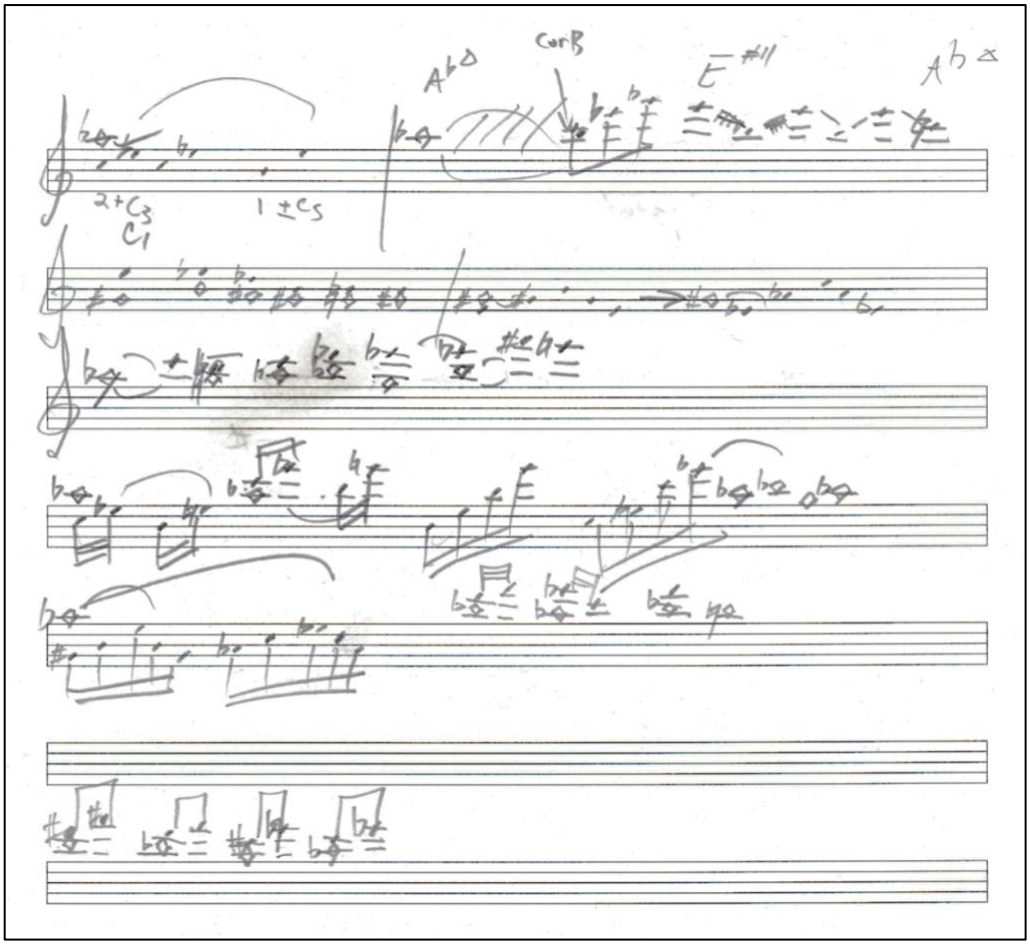


Figure 5-7: Grammar sketch for *Doina*.[158]

5.2.4 Implementation

Rather than develop a score from repeated improvisations, like I had with *Stride*, I instead transcribed a performance I had done of *Doina* for a lecture-recital. Such an approach is used in jazz pedagogy and while the improvised solos of the jazz tradition are not intended to be notated in such a way, it is nevertheless a common exercise. The score can be accessed in Appendix 2 and the recording is linked through fig. 5-9.

[158] Dimond noteheads indicate feedback pitches. At this point, I knew intuitively how to produce them, so no key instructions were included. The second system is transposed down the octave to make space.

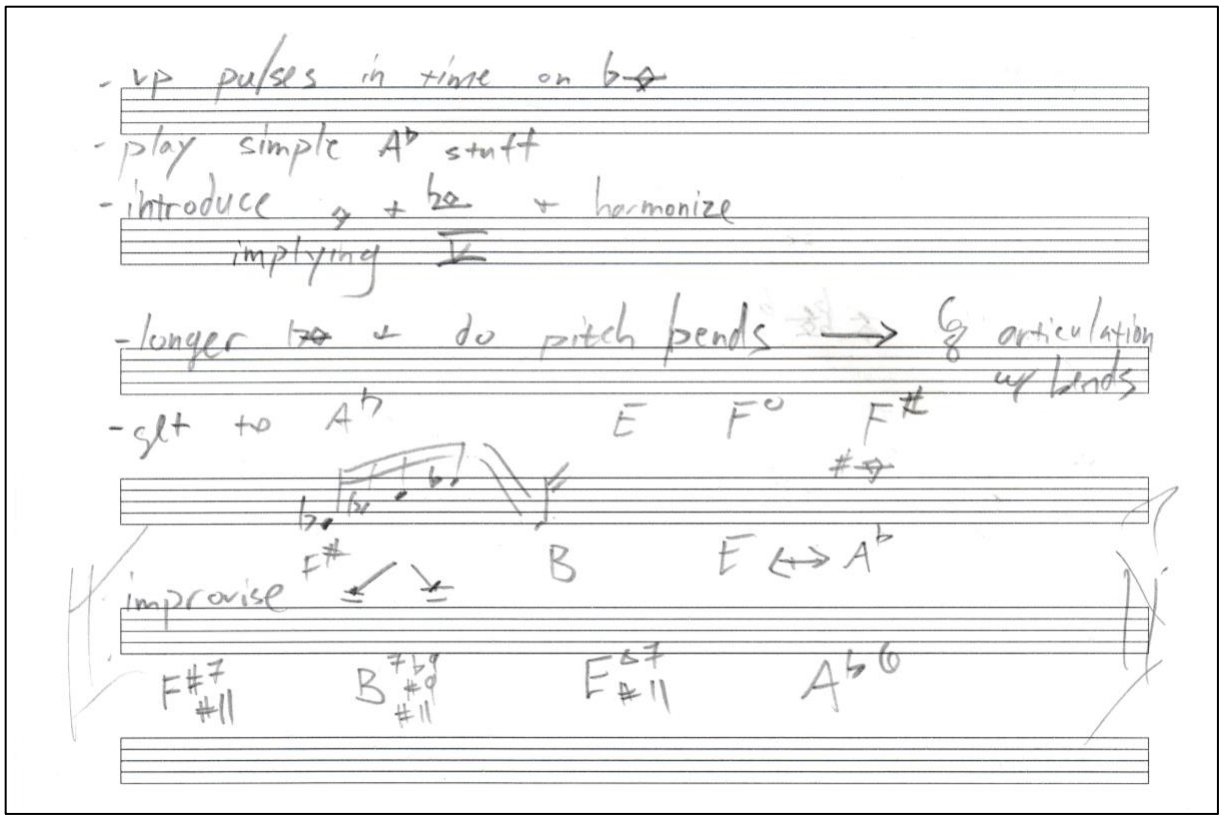


Figure 5-8: Form sketch of *Doina*.

For the finished score, I added a thick horizontal line above the staff to indicate an ongoing feedback tone (fig. 5-9). Accompanying this line are also dynamic markings, which are controlled by the volume pedal. At a glance, a saxophonist may assume the diamond noteheads are harmonics or multiphonics, but the line above the staff should alert any interpreter that something different is required and that they should look to the front matter for instructions. I placed the rehearsal markings relative to where the music changed character or harmony, rather than follow the original form sketch.

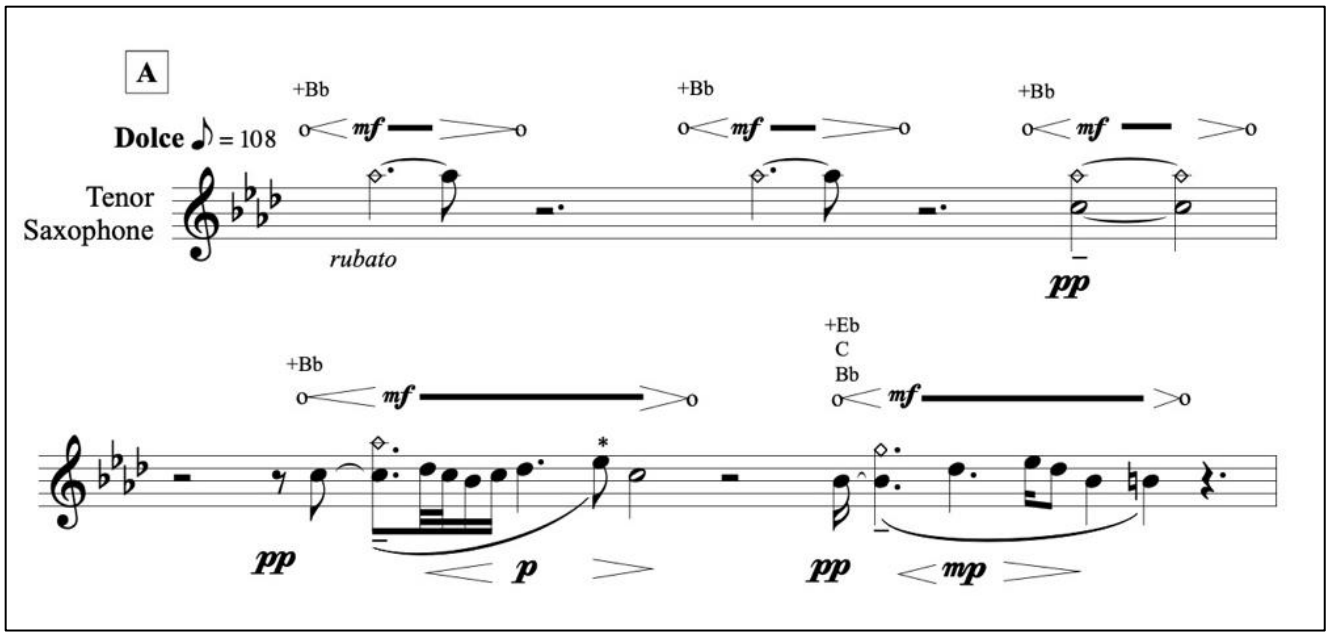


Figure 5-9: Video link for *Doina*.

5.3 Etude No. 3 – *Yen*

5.3.1 Analysis

Having established a variety of grammar, stable equipment, and useful notation for my feedback saxophone instrumentarium, composing was becoming more intuitive and required less analysis. Unlike the first works, for which I could not pre-conceive the musical material, I now had a firm grasp of what my system was capable of and could imagine new combinations of the sounds I had already discovered. Rather than attempt new feedback techniques, this piece explored the grammar I had begun to establish in the first two pieces and drew from the work of Colin Stetson for inspiration. I could not ignore the sonic possibilities that a throat microphone could bring to this instrumentarium, and, moving away from improvising as a method of discovery, I wanted to write a through-composed piece in Stetson's style. Regarding the feedback tones, I had worked with low gestures by themselves in *Stride*, used them as high drones in harmony with similarly pitched acoustic tones in *Doina*, but I had yet to explore high feedback drones over low conventional sounds. These elements laid the conceptual foundation for this last work.

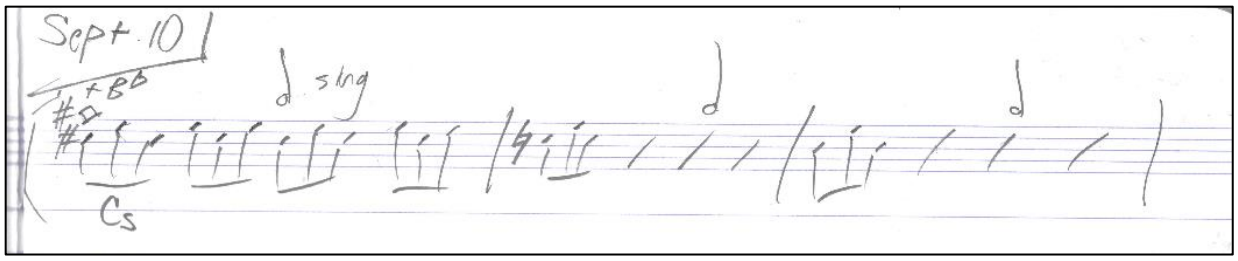


Figure 5-10: Grammar sketch with singing.

5.3.2 Grammar

Figure 5-10 shows a sketch of the primary material for what became the B section of *Yen*.[159] The feedback tone is a high drone over a descending ostinato that changes in a predictable harmonic rhythm. The figure also shows a simple vocalization, which would be amplified through a contact microphone, to add an additional melodic line into the piece's texture. I also continued to refine my instrumentarium and found two pieces of equipment that improved the practical aspect of traveling to perform these works. The Boss FV-50L[160] volume pedal was lighter, smaller, and quieter than the FV-500L, which occasionally made static noise in operation, and the Behringer GM-108[161] amplifier was smaller and lighter than the Roland Cube 30, with most other functions being equal.

5.3.3 Notation

Figure 5-11 shows an early sketch of the form for *Yen*. Unlike *Stride*, with a set form of improvised cells, and *Doina*, a transcription with a form that emerged through its performance, the form of *Yen* was pre-conceived as ABA and then through-composed. The new element of the score, relative to the first two pieces, is the vocal notation. To include this third layer of music in the same staff as the rest of the material, the vocalizations are notated as square noteheads (fig. 5-12).

---

[159] Named so for the desperate yearning sound of the muffled vocalizations.

[160] "FV-50H/FV-50L," BOSS, Accessed April 13, 2023, https://www.boss.info/ca/products/fv-50h_50l/.

[161] "GM108," Behringer, Accessed April 13, 2023, https://www.behringer.com/product.html?modelCode=P0227.

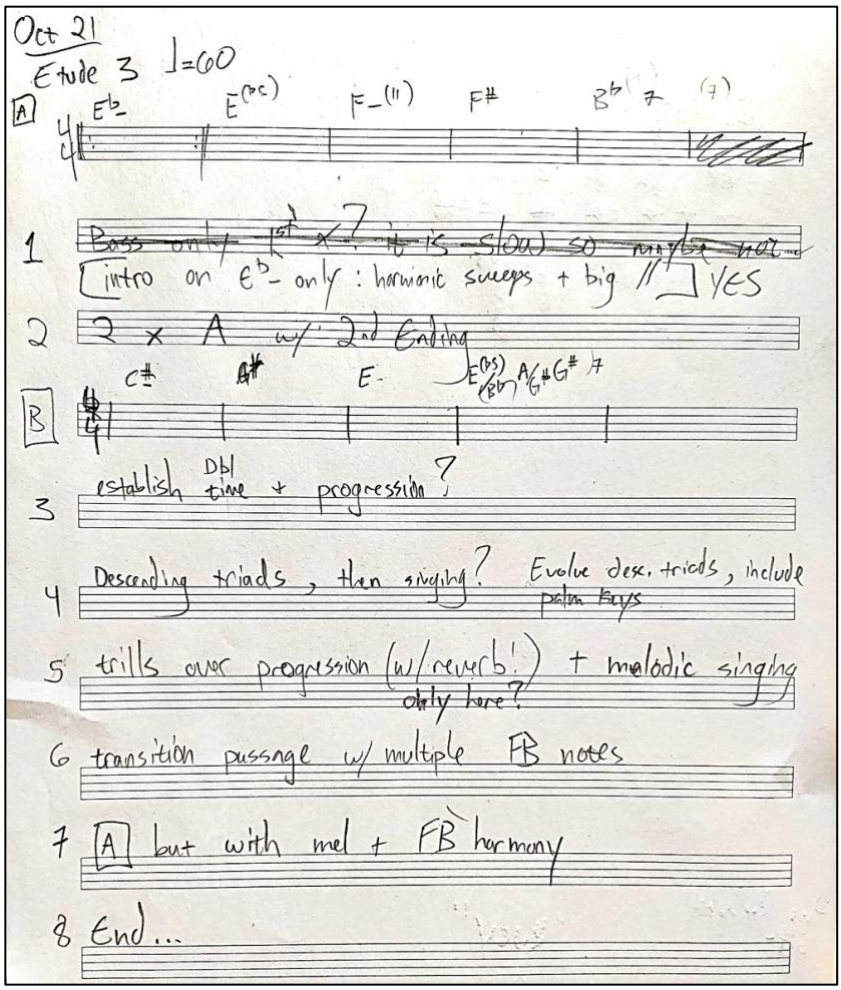


Figure 5-11: Form sketch for *Yen*.

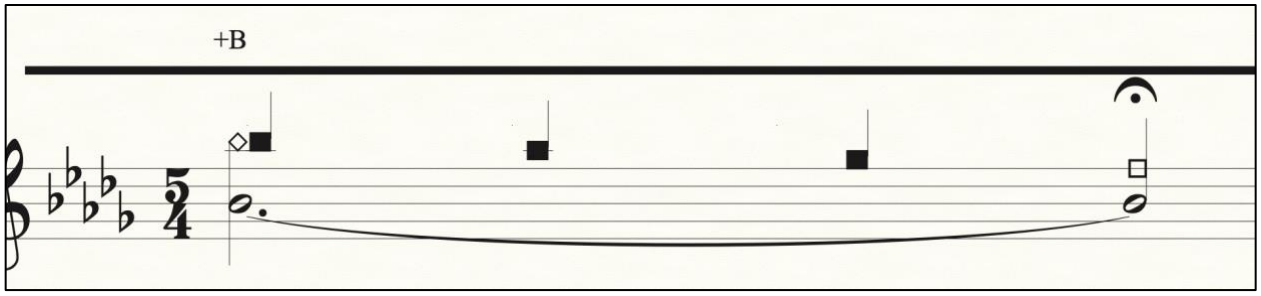


Figure 5-12: *Yen* excerpt.[162]

[162] This shows three voices: conventional, feedback (diamond notehead), and vocal (square noteheads).

5.3.4 Implementation

Rather than in a formalized studio setting, the recording of *Yen* was made live off the floor during a concert I gave at the Canadian Music Centre, Toronto, in the summer of 2022. Despite it being fully composed, and using little improvisation in its interpretation, the score was created after I had done several performances. The score can be found in Appendix 3 and the recording is linked through figure 5-13.

Figure 5-13: Video link for *Yen*.

5.4 Critical Reflection

There are three areas that I address here: my equipment, notation, and musical language. To begin, the system relies heavily on very specific amplifiers – *Stride* can be performed on several, while *Doina* and *Yen* can only be played on two that I have found so far. The Roland Cube 30 and the Behringer GM-108, the only amps that all three works can be performed on, are no longer in production, meaning despite their relative affordability (especially second-hand) they are not easy to find. This has implications for my continued work with the system and creates barriers for others to learn my pieces. I have begun to address this limitation by employing a

digital equalization pedal, the Source Audio EQ2,[163] which has allowed me to "tune" additional amplifiers for use in these works. Though I have had some success in this regard, the process is very much on the edge of my understanding as my knowledge of acoustic feedback is almost purely artistic as opposed to technical, which prevents me from shaping the feedback response of amplifiers in a systematic or rigourous way. In the future, working with an acoustician to understand how my system, amplifiers, and acoustic feedback all work from a technical standpoint could help address this. Such a collaboration could generate scientific analyses of my feedback saxophone practice as it exists and could translate the interactions within my analogue instrumentarium into the digital realm, such as an EQ patch within a DAW or a MAX[164] software patch. Accomplishing this could allow any amplifier to be used, greatly increasing accessibility to these works, and may even expand the capabilities of the system. If this digitization was possible, it would require a laptop to be included into my instrumentarium. While there are clear benefits from doing so, it would contradict the post-digital and minimal nature of this research-creation and greatly impact the performance aesthetic.

Regarding notation, *Stride* could be updated using the most recent and, what seems like, more efficient system of *Doina* and *Yen*. Leaving *Stride* as it is better communicates the process of developing this research-creation, which is of a greater priority for this thesis than dissemination purposes. A colleague of mine, saxophonist and Doctor of Music candidate Tommy Davis, came to my studio for a sight-reading session of my feedback material.[165] In comparing the two notation systems, he found the notation for *Stride* to be "very intuitive" for learning the required material, comparing it to repertoire such as *Le Fusain fuit la gomme* (2001) by Marie-Hélène Fournier. Upon his reading of *Doina* however, it became clear that the transcription, while accurate to what I did in a given performance, was not optimal. Some of the fingerings I used for that performance may be executed with much simpler key combinations, while others are incredibly unstable and hard to replicate (fig. 5-14). Considering this, *Doina* may be an effective

---

[163] "EQ2 PROGRAMMABLE EQUALIZER," Source Audio, Accessed April 13, 2023, https://www.sourceaudio.net/eq2_programmable_equalizer.html.

[164] "What is Max?" Cycling 74, Accessed April 13, 2023, https://cycling74.com/products/max.

[165] February 11, 2023.

document of my practice, but is not a streamlined pedagogical tool or piece of repertoire. Composing a non-improvised version of the work or a wholly new piece that uses more idiomatic feedback grammar, combined with the successful elements of the transcription, is one solution to this.

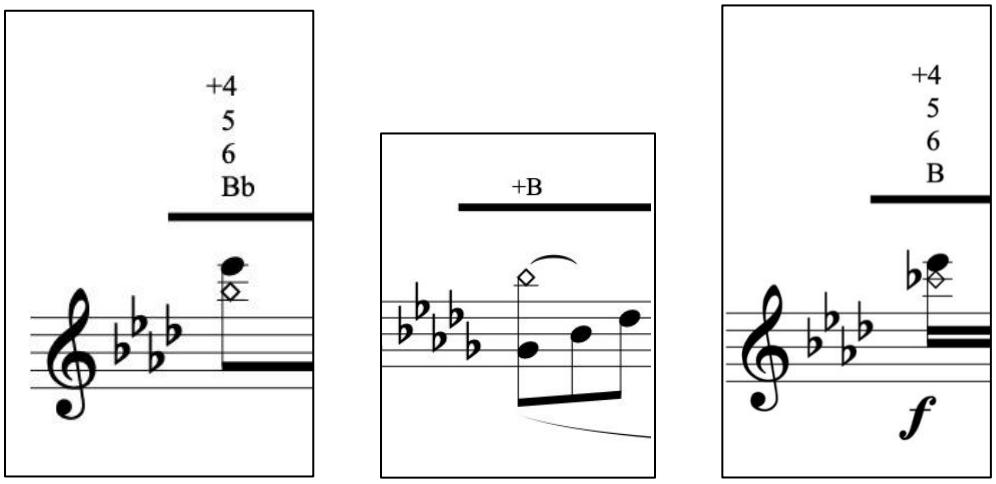


Figure 5-14: Problem feedback notes.[166]

Recently, I premiered the first piece written for this system by another composer, *Inframince: Feedback Saxophone Variations* (2022) by Kevin Gironnay.[167] Working with Gironnay made it clear that a compositional guide to my system would be useful. For saxophonists wanting to play any of my works, the scores should be sufficient to do so, but to compose for the determinate aspects of my system requires a deeper understanding – studying three scores is likely not the most effective way to accomplish this. There is a finite and specific grammar for the system that could be summarized between video and notation that would make the findings of this research more instructive for composers.

The last point of reflection is on the musical language. I have received some criticism that the harmonic and rhythmic grammar of these works are not adequately complex in regard to

---

[166] Comparing the same feedback note, Bb (diamond notehead) in *Doina* (left) and *Yen* (centre). The Cb in *Doina* is also very unstable (right).

[167] Performed Dec 9, 2022 at the *live@CIRMMT* concert series, McGill University, Montreal. See the performance here.

contemporary classical saxophone language. While this is true, the works' relative simplicity is a functional aspect in their use as reflexive tools, research documents, and creative artefacts within a particular musical aesthetic. These feedback saxophone works are meant to codify the fundamental equipment and musical grammar of this system to establish a foundation on which a much larger practice is emerging. Consequently, these pieces should be understood as etudes, which are works that systematically aid performers in the mastery of particular musical concepts of increasing complexity. Polish composer and piano virtuoso Frédéric Chopin's (1810-1849) piano etudes are among the most famous of these, transcending their role as pedagogical tools to become part of the fabric of the Western classical music tradition. Similarly, in contemporary saxophone practice, French composer Christian Lauba's (b.1952) *Neuf Études*[168] (1996) have become important pedagogical tools for teaching extended techniques, as well as a staple in classical performance competitions. Similarly functioning works exist in the electroacoustic world as well, one example being *Suite no.14 (Suite pour quatorze instruments)* (1949) by *musique concrète* pioneer Pierre Schaeffer (1910-1995). Scholar Carlos Palombini notes:

> According to Schaeffer, the traditional (or "abstract") composer follows a path that leads him from the abstract to the concrete. The traditional piece is mentally conceived, symbolically notated, and finally performed. In musique concrète, the effects created by different manners of exciting sound-producing bodies, and by electroacoustic manipulations of recordings of these sounds, cannot be conceived a priori...The new (or "concrète") composer can do no better than manufacture his material, experiment with it, and finally put it together.[169]

While the etudes of Chopin and Lauba were designed to be widely played and to advance the technical capabilities of their respective instruments, Schaeffer could not pre-conceive the sonic results of his new techniques, so *Suite no. 14* was a way for the French composer to systematically explore and develop his own compositional grammar. Much like the structure of other etude collections, *Suite no. 14* begins simply and increases in complexity. According to Palombini, "the suite had the following movements: *prologue*, *courante*, *rigaudon*, *gavotte*, and *sphoradie*. Each of these pieces was an experiment with a particular technical procedure…In the

---

[168] Christian Lauba, *Neuf Etudes for Saxophones in 4 books*, (Paris: Alphonse Leduc, 1996).

[169] Carlos Palombini, "Machine Songs V: Pierre Schaeffer: From Research into Noises to Experimental Music," *Computer Music Journal* 17, no. 3 (1993): 15.

prologue, no more than reverberations, echo, doublings, and rhythmic counterpoint were added. The *sphoradie* in turn was meant as 'an essay of expression properly speaking,' freely employing various technical procedures."[170] Like *Suite no. 14*, my feedback saxophone works are reflexive etudes used to establish the musical grammar of my own system. In providing the exact details required to perform the works themselves and learn this practice, these etudes also function as research documents. In working with a novel electroacoustic musical system without any existing documentation, I similarly could not pre-conceive the musical results and therefore had (and have) to systematically develop it beginning with basic musical material. Instead of "freely employing various technical procedures"[171] as in the last movement of *Suite no. 14*, these etudes document the initial stages of research-creation. Moreover, much like the first *concrète* pieces of Schaeffer or early pieces in a collection of etudes, my works introduce listeners, interpreters, and scholars to the fundamental phenomenon of feedback saxophone, explicitly and clearly.

Considering this, the expressive and technical scope of feedback saxophone far exceeds what I have formally explored, and three short pieces only begin to realize its potential. However, to carry out this research-creation in a thorough manner, complete with background and contextual research, as well as detailed descriptions of my methodological framework and the creative processes and products, limiting myself to these three pieces for my doctoral research seemed appropriate. Although composing relatively simple works served the purposes of this research, and perhaps suited my own skill as a composer of classical music, I am eager to perform and hear further "essays of expression" for my feedback saxophone system by other composers.

Before concluding, I have some comments on further developing this research. I have pages of notes of different feedback pitches and gestures I discovered while improvising that have yet to be used in formal pieces. Without changing anything about my system, this could yield a large body of work. There are also natural extensions to the system that would expand its potential. For example, the Roland CUBE 30 amplifier has several built-in effects that can easily be engaged. Amazingly, the tremolo, reverb, and delay all act as intended without compromising

---

[170] Palombini, "Machine Songs," 16.

[171] Palombini, "Machine Songs," 16.

the current feedback grammar. This has led me to "play" the amplifier on its own: using a single feedback pitch and manipulating the amplifier's effects and other settings to create musical gestures. Drawing from the work of Davies, I am excited to send various waveforms through the amplifier to try and replicate the ring modulator effect used in *Quintet*. I am also curious about how performing with multiple amplifiers and/or multiple microphones would expand the system. At the beginning of this chapter, I mention that the smaller alto saxophone did not yield convincing feedback pitches, but what if I used this equipment on a larger baritone, or even bass, saxophone? Such ideas would take years to fully explore, whether by me or someone else.

Even without these potential extensions, this research innovates on contemporary saxophone and electroacoustic practice in several ways. There are other works that feature saxophone-controlled feedback, notably Agostino Di Scipio's *Modes of Interference / 2* (2006).[172] Like many of his predecessors interested in feedback, such as Davies (see Chapter 3), Di Scipio employs a graphic score to lead the performer in a process-based feedback piece, meaning the sounds are indeterminate. Like Davies' *Quintet*, *Modes of Interference / 2* is a microphonic piece unconnected to broader instrumental practice. John Butcher's feedback saxophone is an ongoing practice but still employs indeterminacy, so his work remains esoteric. In contrast to the indeterminate feedback works of Di Scipio, his classical forebears, and Butcher, my research systematizes the feedback response so that through-composed and otherwise determinate works may be created. Furthermore, through codifying feedback saxophone through these determinate works, I may develop and disseminate feedback saxophone in ways that are distinct from Butcher.

Though Butcher is my closest peer regarding the fundamental technical innovation of this research, Colin Stetson is an important aesthetic influence. His avant-pop style combines the microphonic process, virtuosic extended techniques, and popular musical forms and material. I consider Stetson to be one of the most important saxophonists of our time, yet his output has largely been overlooked by academia – likely due to his position within popular music (a bias seemingly shared by Stockhausen). In drawing from Stetson's practice, I hope to bring more

---

[172] Agostino Di Scipio, *Modes of Interference / 2*, (Self-Published, 2006).

academic attention to his work and contribute to avant-pop as a useful aesthetic in research for its documentary and pedagogical clarity. Moreover, like Stetson (and Butcher) I employ the microphonic process under the guiding principles of post-digitalism. Rather than maximally augment my saxophone with digital media, I instead minimally augment it with rudimentary analogue equipment, and then harness the noise and idiosyncrasies of the instrumentarium through new techniques. Such an approach engages with technology without falling victim to the negative consequences of the consumerist "sound" paradigm, instead using instrumental technique or "style" as the driving creative force. This demonstrates how post-digitalism and minimally augmented instruments can innovate performance practice and provide a meaningful alternative to digital modes of creation.

Lastly, these works demonstrate a particular approach to AGNI, which I carried out using methods that suit my musical expertise. My iteration of AGNI could be used for creating works or practices involving new electronic or electroacoustic instruments, new acoustic instruments, or newly discovered acoustic instrumental techniques. This research also demonstrates how improvisation can be a useful tool in artistic research. Despite Henk Borgdorff's assertion that "Inadvertent (fortuitous) contributions to knowledge and understanding cannot be regarded as research results,"[173] improvisation was a primary method in this work. While the results of improvisation (or comprovisation) may be serendipitous, they are not inadvertent, as they are sought after in a systematic way. My feedback saxophone discovery is a useful example of this distinction: while the encounter was unexpected, I immediately and intentionally employed it as a musical device, leading to the discovery of the finger-to-feedback relationship and, eventually, this research.

---

[173] Borgdorff, *Conflict of the Faculties*, 42. See also Chapter 1.

Conclusion

The microphonic process is a phenomenon whereby musicians employ microphones and related media within a musical instrumentarium to innovate musical practice. Beginning with the conversational crooning of early microphone singers, the microphonic process transformed live performance practice and continues to be an innovating force today. In this research-creation thesis I described the advent of the microphonic process and discussed its history through the music of Bing Crosby, Karlheinz Stockhausen, Hugh Davies, and Jimi Hendrix. I then showed how microphonic practices continue in the 21st century through saxophonists Colin Stetson and John Butcher, and ended with a discussion and analysis of how I newly applied the microphonic process in my own feedback saxophone work.

This research embodies the epistemological promise of research-creation to meaningfully combine artistic practice with scholarly inquiry. Though there remains opposition to this concept, research-creation is becoming more widely understood to compliment conventional forms of scholarship by contributing to artistic knowledge. Many academics agree that to use creative practice as research, its methods and findings must be made explicit and communicated clearly. Creative practice without any exegesis should be viewed as art for art's sake, and not be considered, nor held to the standards of, scholarly research. Rather than producing a binary of "pure" research-creation and "pure" art, varying degrees of creative practice can be applied as a research method or act as findings. This spectrum of research methods and results is illustrated by my music research compass, on the centre of which lies my research that balances conventional and artistic methods and results. By combining creative practice with discursive analysis, my "problem-practice-exegesis" methodology ensures that my research-creation was systematically carried out, that it was contextualized for academic and artistic communities, and that it produced original contributions. This methodology can be used as a model for other research-creation projects in general, while my version of the AGNI method, used within, could be applied for similarly situated research.

Examining the history and current state of the microphonic process reveals a cross-genre, musical-technological practice spanning nearly 100 years. This practice cannot be fully appreciated without understanding how drastically popular vocal technique was transformed by

the shift from pre-electric, acoustical sound reproduction technology to that of the microphone, amplifier, and loudspeaker. In both recordings and live performance, the convergence of these three technologies was most effectively harnessed by Bing Crosby, whose microphone-enhanced crooning made him a multimedia superstar. Those familiar with his rise to fame understood that he was perceived as using the microphone as an instrument, but his success contributed to the microphone's complete assimilation into musical practice, thus obscuring its instrumental nature. Cathy van Eck, whose writing on microphones and loudspeakers as musical instruments has been invaluable to this research, is one of many who take the microphone's assimilation into musical practice at face value. The device had become such a natural, expected inclusion in vocal performance that even microphone techniques, such as changing the distance from the singer's mouth, were not considered instrumental interactions by her. Karlheinz Stockhausen also had this bias, not even viewing the microphone as an extension of the body, but as lifeless as a piece of furniture. This attitude allowed Stockhausen to believe that he was revitalizing the microphone as an instrument, ignoring the performance innovations of popular singers in the 40 years leading up to the creation of *Mikrophonie I*.

Treating *Mikrophonie I* as a work that engages in the microphonic process, however, shifts the focus away from the microphone and towards the work's instrumentarium of media. Moreover, much like the spectrum of creative practice in research, my analysis of the microphonic process does not rely on a binary of instrumental nature. It instead recognizes the varying degrees and ways all media within an instrumentarium contribute to musical outcomes, regardless of the genre or historical period. Using the microphonic process as a framework then allows the musical-technological relationships within *Mikrophonie I* to be compared with the singing of Bing Crosby. Continuing to apply this framework, in harnessing the acoustic feedback between microphones and loudspeakers, Hugh Davies' *Quintet* achieved a much greater degree of instrumental revitalization than *Mikrophonie I* ever did. Despite Davies' success, indeterminate feedback works are still uncommon in the classical world. This should come as no surprise, as the microphonic pieces of Stockhausen and Davies were never intended or expected to have implications beyond the avant-garde sphere. Successful musical-technological fusions in popular music, however, often are. Bing Crosby's crooning was the first microphonic practice to gain wide appeal, followed by Jimi Hendrix's electric guitar feedback. By transforming what was initially intended as a sound reproduction device into a vital part of an instrumentarium, capable

of catalyzing new performance techniques, Hendrix did for the loudspeaker what Crosby did for the microphone.

By repurposing microphones, loudspeakers, amplifiers, mixing boards, and more, these four ground-breaking artists divergently employed the microphonic process to innovate their genres. Though their full impact remains to be seen, the works of saxophonists Colin Stetson and John Butcher present significant innovations in saxophone performance practice and continue the lineage of the microphonic process that has been evolving since the 1920s. Following in the footsteps of Crosby and Hendrix, and borrowing from the experimental realm of Stockhausen and Davies, Stetson has used the microphonic process to package extended saxophone techniques into a new style of instrumental avant-pop. Unlike the packaging of Stetson, Butcher likely pioneered an entirely new technique in manipulating indeterminate feedback with the saxophone, using it in free improvisations that forgo systematization.

Despite the accelerating adoption of digital technology in the 21st century, the instrumentaria of Stetson and Butcher avoid digital media – defying the longstanding relationship between technological innovation and musical practice. Throughout most of the 20th century, new technologies were used to develop novel performance techniques, as the works of Crosby, Stockhausen, Davies, and Hendrix demonstrate. According to Paul Théberge, however, the increased availability of digital hardware and software in the 1980s began to fundamentally shift musicians' technical relationship with technology, referred to as the style paradigm, towards a consumerist one, referred to as the sound paradigm. This meant that, rather than develop new musical experiences through technologically extended instrumental technique, musicians were more likely to acquire the newest devices and software to stay current. Though the sound paradigm played out somewhat differently in classical music, responses to the sound paradigm's shortcomings included "interactive" computer music and digitally augmented instruments.

In spite, or perhaps because, of the cutting-edge nature of digital enhancement, the extensions used in augmented instruments frequently overshadow the technique and acoustic qualities of the core instrument, which is one of the reasons they have failed to meaningfully impact woodwind performance practice. Under the guiding principles of post-digitalism, however, minimally augmented instruments can provide a model for integrating woodwinds with technology without being consumed by the sound paradigm. In harnessing the idiosyncrasies, accidents, and noise of

both media and acoustic instruments, minimally augmented instruments recentre musical-technological relationships on technique and away from consumption. The instrumentaria of Stetson and Butcher are excellent examples of this concept: by using the fundamental technologies of the microphonic process to innovate saxophone technique, these artists have contributed to saxophone performance practice in lasting ways that will be largely unaffected by changing tastes or new technological innovations.

My work in feedback saxophone similarly reimagines the saxophone as a minimally augmented, post-digital instrument, and uses the microphonic process to expand its expressive capabilities. To exhibit the creative potential and to establish the fundamental grammar of this new instrumentarium, I composed three concert etudes, *Stride, Doina,* and *Yen*. With each work increasing in complexity, they build the foundation of what is becoming a much deeper practice and clearly document the research-creation for interested parties. Despite the preliminary nature of these works, they represent a hitherto undocumented and under-explored approach to electroacoustic performance and instrumental practice. Perhaps most significantly, they show how acoustic feedback may be systematized, something that has not been meaningfully done before or since Jimi Hendrix. These works demonstrate that the microphonic process, as well as musical-technological approaches that embrace limitations and material imperfection, such as post-digitalism, are means by which new sounds, techniques, and musical aesthetics may be developed. The utility of these approaches highlights the importance of studying disparate artists across genres and times, which is reinforced by my research on the microphonic process. The expressive cache of novel phenomenon based in human interactions with physical instrumentaria will likely grow in importance as digital hegemony increases. Ultimately, this research shows there is much to be gained by rethinking the possibilities of everyday technologies and creatively engaging with the material world.

References

Andrews, Jeff. “Colin Stetson Makes You Forget Everything You Know About the Saxophone.” *VICE*, May 5, 2017. https://www.vice.com/en/article/jpy89y/colin-stetson-makes-you-forget-everything-you-knew-about-the-saxophone.

Bhagwati, Sandeep. “Sounding the Climate we Live in: On Ways and Means of Artistic Research in Music and Sound.” (Draft Paper) The AEC European Platform for Artistic Research in Music EPARM 2021. 18-21 March 2021, Online. (A)

Bhagwati, Sandeep. “Sounding the Climate we Live in: On Ways and Means of Artistic Research in Music and Sound.” (Power Point Slides) The AEC European Platform for Artistic Research in Music EPARM 2021. 18-21 March 2021, Online. (B)

Boles, Benjamin. “Colin Stetson.” *NOW Magazine*, August 25, 2011. https://nowtoronto.com/colin-stetson.

Borgdorff, Henk. *The Conflict of the Faculties Perspectives on Artistic Research and Academia*. Leiden, Netherlands: Leiden University Press, 2012.

Bowers, John, and Phil Archer. “Not Hyper, Not Meta Not Cyber but Infra-Instruments.” In *Proceedings of the 2005 International Conference on New Interfaces for Musical Expression*, 5-10. 2005.

Burtner, Matthew. “The Metasaxophone: Concept, Implementation, and Mapping Strategies for a New Computer Music Instrument.” *Organised Sound* 7, no. 2 (2002): 201-213.

Butcher, John. *Invisible Ear*. Bandcamp. Weight of Wax, 2003.

Coules, Andy. “The History of Live Sound – Part 1.” Harman Professional Solutions – Insights. Accessed April 13, 2023. https://pro.harman.com/insights/av/the-history-of-live-sound-part-1/.

Croft, John. “Composition is not Research.” *Tempo* 69, no. 272 (2015): 6-11.

Di Scipio, Agostino. *Modes of Interference / 2*. Self-Published, 2006.

Dudas, Richard. “‘Comprovisation’: The Various Facets of Composed Improvisation within Interactive Performance Systems.” *Leonardo Music Journal* 20 (2010): 29-31.

Dunin-Woyseth, Halina. “Some Notes on Mode 1 and Mode 2: Adversaries or Dialogue Partners?” In *The Routledge Companion to Artistic Research in the Arts*. Edited by Michael Biggs and Henrik Karlsson, 64-81. New York: Routledge, 2011.

edgare. “John Butcher at All Tomorrow’s Parties.” YouTube. Dec 12, 2010. https://www.youtube.com/watch?v=uCjrN8ZuIqM.

d'Escriván, Julio. “To Sing the Body Electric: Instruments and Effort in the Performance of Electronic Music.” *Contemporary Music Review* 25, no. 1-2 (2006): 183-191.

Ferguson, John R., and Andrew R. Brown. “Fostering a Post-Digital Avant-Garde: Research-Led Teaching of Music Technology.” *Organised Sound* 21, no. 2 (2016): 127–37.

Fischer, Michael C. “Michael Fischer, feedback-saxophone, Vienna 2018.” YouTube. April 9, 2019. https://youtu.be/JTRkuAcFsWw.

Garnett, Guy E. “The Aesthetics of Interactive Computer Music.” *Computer Music Journal* 25, no. 1 (2001): 21-33.

Giddins, Gary. “Bing Crosby, The Unsung King of Song,” *New York Times*. January 28, 2001. https://www.nytimes.com/2001/01/28/books/music-bing-crosby-the-unsung-king-of-song.html.

Google Arts and Culture. “W49 Hörspielverzerrer.” Accessed March 23, 2023. https://artsandculture.google.com/asset/w49-h%C3%B6rspielverzerrer-firma-h-maihak-ag-hamburg/-QGxLY3VP63lfg?hl=en.

Hanford I.I.I., John C. “With the Power of Soul: Jimi Hendrix in Band of Gypsys.” PhD diss., University of Washington, 2003.

Herald, Christopher R. “The Advent of an Artist-Composer Movement Exemplified by the Works of Saxophonists Colin Stetson, Evan Parker, and Contemporaries.” DMA diss., University of Arizona, 2017.

Horning, Susan Schmidt. *Chasing Sound: Technology, Culture & the Art of Studio Recording from Edison to the LP*. Baltimore: Johns Hopkins University Press, 2013.

Huddersfield Contemporary Music Festival. “Solos and plurals: the improvisation of John Butcher.” Accessed April 17, 2020. https://hcmf.co.uk/solos-and-plurals-the-improvisation-of-john-butcher/.

Kant, Immanuel and Mary J. Gregor. *The Conflict of the Faculties = Der Streit Der Fakultäten*. New York: Abaris Books, 1979.

Kjørup, Søren. “Pleading for Plurality: Artistic And Other Kinds Of Research.” In *The Routledge Companion to Research in the Arts*, edited by Michael Biggs and Henrik Karlsson, 54-73. Routledge: New York, NY, 2011.

Kolkowski, Aleksander, and Alison Rabinovici, “Bellowphones and Blowed Strings: The Auxeto-Instruments of Horace Short and Charles Algernon Parsons.” In *Material Culture and Electronic Sound. Edited by Frode Weium and Tim Boon*, 1-42. Smithsonian Institution Scholarly Press, Washington, D.C., 2016.

Lauba, Christian. *Neuf Etudes for Saxophones in 4 books*. Paris: Alphonse Leduc, 1996.

Lockheart, Paula. “A History of Early Microphone Singing, 1925-1939: American Mainstream Popular Singing at the Advent of Electronic Microphone Amplification,” *Popular Music and Society* 26, no. 3 (2003): 367-385.

Londeix, Jean-Marie. *Tablature des Doigtes compares des Notes suraigues*. Paris, France: Alphonse Leduc, 1974.

McCracken, Allison. “‘God’s Gift to Us Girls’: Crooning, Gender, and the Re-Creation of American Popular Song, 1928-1933.” *American Music* 17, no. 4 (1999): 365-395.

McPherson, Andrew P., and Youngmoo E. Kim. “The Problem of the Second Performer: Building a Community Around an Augmented Piano.” *Computer Music Journal* 36, no. 4 (2012): 10-27.

Mooney, James. “Grey Area performs: Hugh Davis, Stockhausen, Christian Wolff, Owen Green.” Program notes for *Quintet*, 5.

Mooney, James. “The Hugh Davies Collection: live electronic music and self-built electro-acoustic musical instruments, 1967-1975.” *Science Museum Group Journal* 7, Spring (2017). http://journal.sciencemuseum.org.uk/browse/issue-07/the-hugh-davies-collection/.

Pace, Ian. “Composition And Performance Can Be, And Often Have Been, Research.” *Tempo* 70, no. 275 (01, 2016): 60-70.

Palacio-Quintin, Cléo. “2008: Eight Years of Practice on the Hyper-Flute: Technological and Musical Perspectives.” In *A NIME Reader Current Research in Systematic Musicology*, vol. 3. Edited by A.R Jensenius and M.J. Lyons, 335–351. Springer, Cham, 2017.

Palacio-Quintin, Cléo. “Composition d’oeuvres pour hypre-flûtes et traitement audionumérique interactif.” DM thesis, Université de Montréal, 2011.

Palombini, Carlos. “Machine Songs V: Pierre Schaeffer: From Research into Noises to Experimental Music.” *Computer Music Journal* 17, no. 3 (1993): 14–19.

Polaris Music Prize. “About.” Accessed Sept 10, 2022. https://polarismusicprize.ca/about/.

Potter, John, and Neil F. Sorrell. *A History of Singing*. Cambridge: Cambridge University Press, 2014.

Richards, John. “Getting the Hands Dirty.” *Leonardo Music Journal* 18, (2008): 25-31.

Schloss, W. Andrew. “Using Contemporary Technology in Live Performance: The Dilemma of the Performer.” *Journal of New Music Research* 32, no. 3 (2003): 240.

Skains, R. Lyle. “Creative Practice as Research: Discourse on Methodology.” *Media Practice and Education* 19, 1 (2018): 82-97.

Skains, Lyle. “PBR Method.” Creative Practice as Research: Discourse on Methodology. Accessed July 5, 2021. https://scalar.usc.edu/works/creative-practice-research/media/pbr-method.

Social Sciences and Humanities Research Council. “Definitions of Terms.” Accessed June 15, 2021. https://www.sshrc-crsh.gc.ca/funding-financement/programs-programmes/definitions-eng.aspx#a3.

Stetson, Colin. *New History Warfare Vol 2: Judges*. Constellation, 2011. LP.

Stockhausen, Karlheinz. *Mikrophonie I: für Tamtam, 2 Mikrophone, 2 Filter und Regler, Nr. 15, 1964: 6 Spieler*. London: Universal Edition, 1974.

Stockhausen, Karlheinz, and Jerome Kohl. “Electroacoustic Performance Practice.” *Perspectives of New Music* 34, no. 1 (1996): 74-105.

Stockhausen, Karlheinz, and Robin Maconie. *Stockhausen on Music: Lectures and Interviews*. London: Marion Boyars, 1989.

The Association Européenne des Conservatoires, Académies de Musique et Musikhochschulen (AEC). “Key Concepts for AEC Members Artistic Research An AEC Council ‘White Paper’, 2015.” Accessed February 5, 2021. https://www.aec-

music.eu/userfiles/File/Key%20Concepts/White%20Paper%20AR%20-%20Key%20Concepts%20for%20AEC%20Members%20-%20EN.pdf.

Théberge, Paul. *Any Sound You Can Imagine: Making Music / Consuming Technology*. Hanover: Wesleyan University Press, 1997.

van Eck, Cathy. *Between Air and Electricity.* New York: Bloomsbury Academic, 2018.

Wikipedia. "John Butcher." Accessed May 4, 2022. https://en.wikipedia.org/wiki/John_Butcher_(musician)

Williams, Sean. "Stockhausen Meets King Tubby's: The Transformation of the Stepped Filter into an Instrument." In *Material Culture and Electronic Sound*. Edited by Frode Weium and Tim Boon, 159-184. Washington, D.C.: Smithsonian Institution Scholarly Press, 2016.

Appendix 1: Score for *Stride*

S T R I D E

For Feedback Tenor Saxophone

Greg Bruce 2020

~5:30 – 7:00

Greg Bruce

Stride

for feedback tenor saxophone

2020

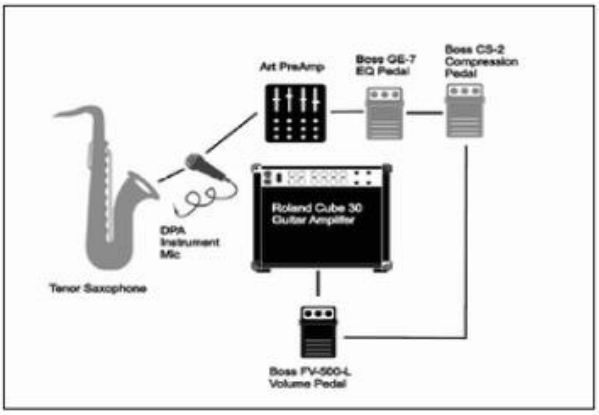
Equipment and Setup Instructions

This is Etude No. 1 for the original feedback saxophone system that I developed during my doctoral studies at the University of Toronto. There is no conventional playing in this piece, it is *feedback only.*

Equipment

- Shure Betal 57 or DPA 4060 microphone
- Art Preamplifier (optional)
- Boss GE-7 Pedal
- Boss CS-3 Compression Pedal
- Boss FV-50L Volume Pedal (or 500L)
- Roland CUBE 30 COSM, Behringer GM-108 Amplifier, Fender '65 Deluxe Reverb (standard model), Yorkville KW50 keyboard wedge
- Stool (barstool height) or table for amplifier
- Power Bar
- 9V Power Supply with Daisy Chain
- Min. two short ¼" unbalanced patch cables
- Min. two 6' ¼" unbalanced patch cables
- One 10' Female XLR to Male ¼" unbalanced (if not using a preamp)

Setup



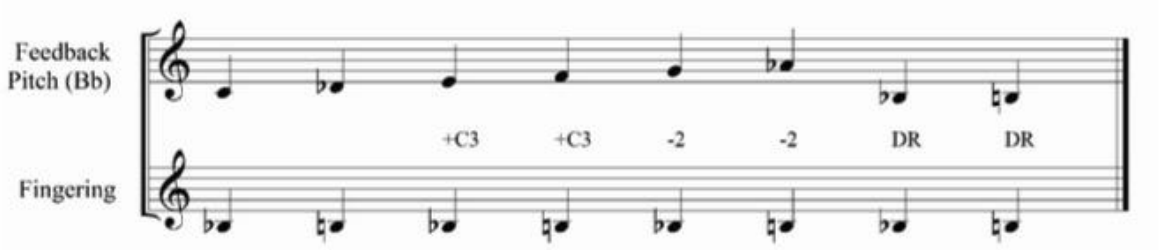
- I *strongly* encourage the use of earplugs when first learning this system.
- The amp should be sitting on a table or stool that is waist high.
- The volume pedal must be on the floor, near the amp. The other pedals can be wherever is convenient.
- The performer should be facing the amp with their right side towards the audience and the bell of the tenor saxophone nearly touching the grill covering the speaker.
- The microphone must be deep in the bell of the instrument. Use a piece of tape or saxophone mute to ensure it stays in place.
- The ART preamp is used to give phantom power to the DPA mic and allows for fine tuning the gain, a different preamp or even mixer could be used – though they may affect the tuning of the feedback notes.

- While other pedals may work, those listed will allow you to interpret the piece as accurately as possible. These are the rough settings for these pedals – you will likely need to adjust depending on the room, the saxophone, etc.
    - Amp: volume/gain will be between 1 and 3. The low/bass knob will need to be turned slightly past noon, while the high/treble knob will need to be turned slightly before noon.
    - Compression pedal: level and tone at around 10:00, attack and sustain at max.
    - EQ pedal: the first three bands should be maxed, the middle two at 50%, the last two at 0%.
- Always start your practice sessions with the amplifier off and the volume pedal heel down.
- Turn on the compression and EQ pedals, followed by the amp, and then slowly angle the toe downwards on the volume pedal until you hear feedback.
- Feedback is created without blowing into the instrument and can be combined with conventional operation of the saxophone.

Notation

This is a transposing performance score, written for Bb tenor saxophone.

The feedback pitches you will get from the fingerings below are approximate but should be in the vicinity of the same notes on tenor sax. If you are having difficulty producing the lowest feedback pitches, the amp you are using is likely incompatible with this setup.



DR = Dampen Reed. Using the tongue, press the tip of the reed against the tip of the mouthpiece, completely sealing the mouthpiece shut.

The fingering instructions use the European, or "Londeix," fingering shorthand.

An arrow means to improvise with the given material up to the indicated time.

When the bottom staff disappears, use the fingerings from the previous gesture.

All written dynamics are controlled by the Volume Pedal, with ***pp*** being roughly 10% on and ***ff*** being 90%

Contact
If you have any questions, please email me at:
gregthesquare@gmail.com

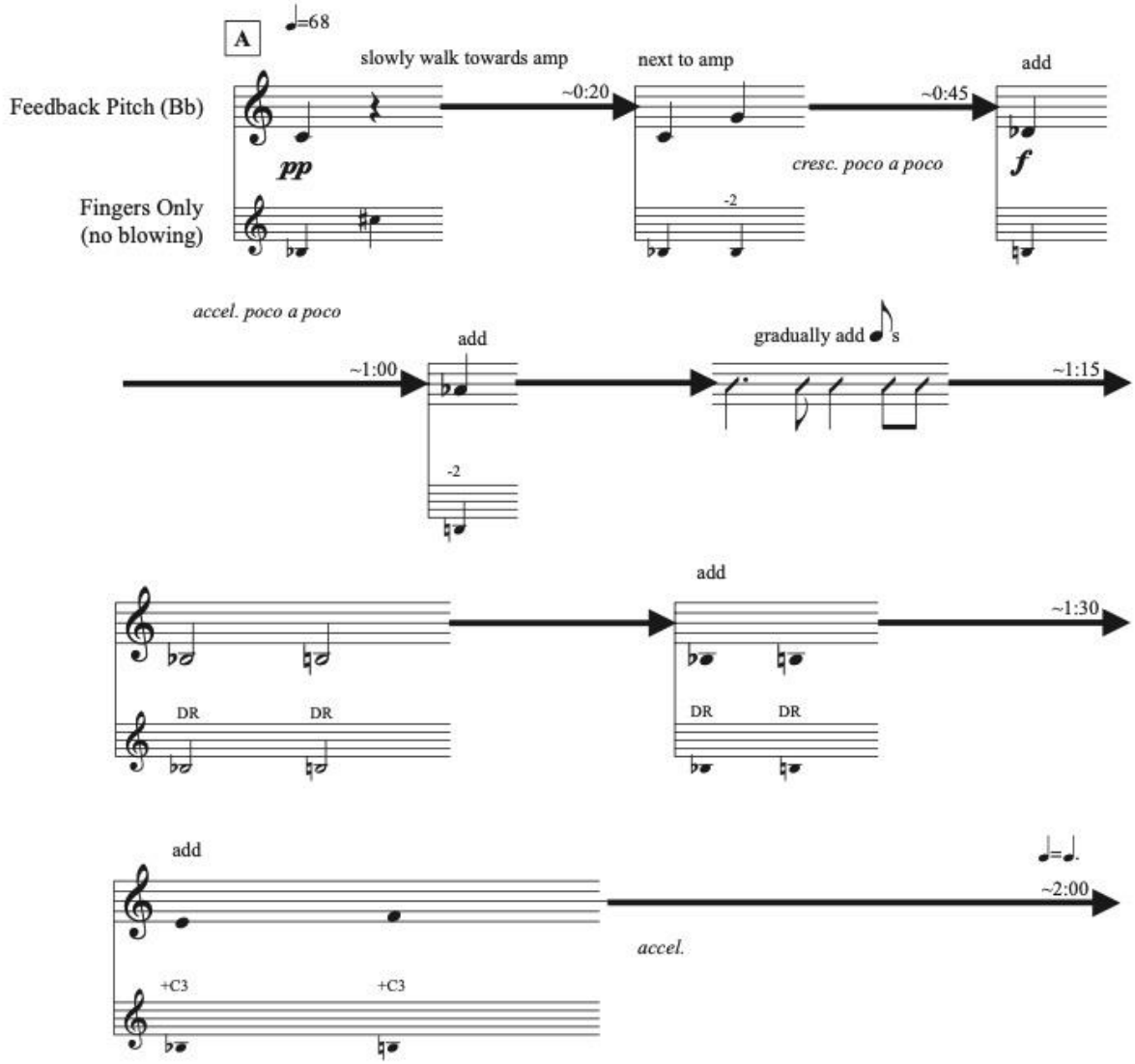
You can see performances of this piece and my other feedback works on my YouTube channel:
www.youtube.com/@gregthesquare4

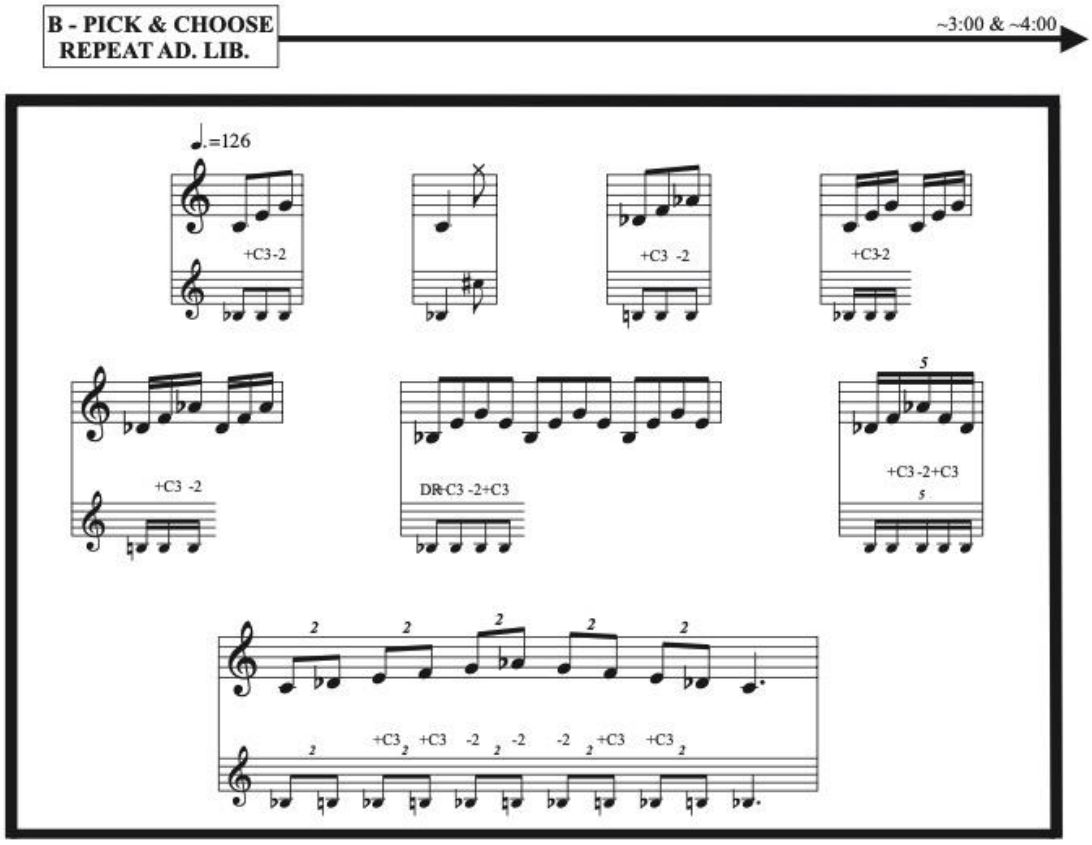
Tenor Saxophone

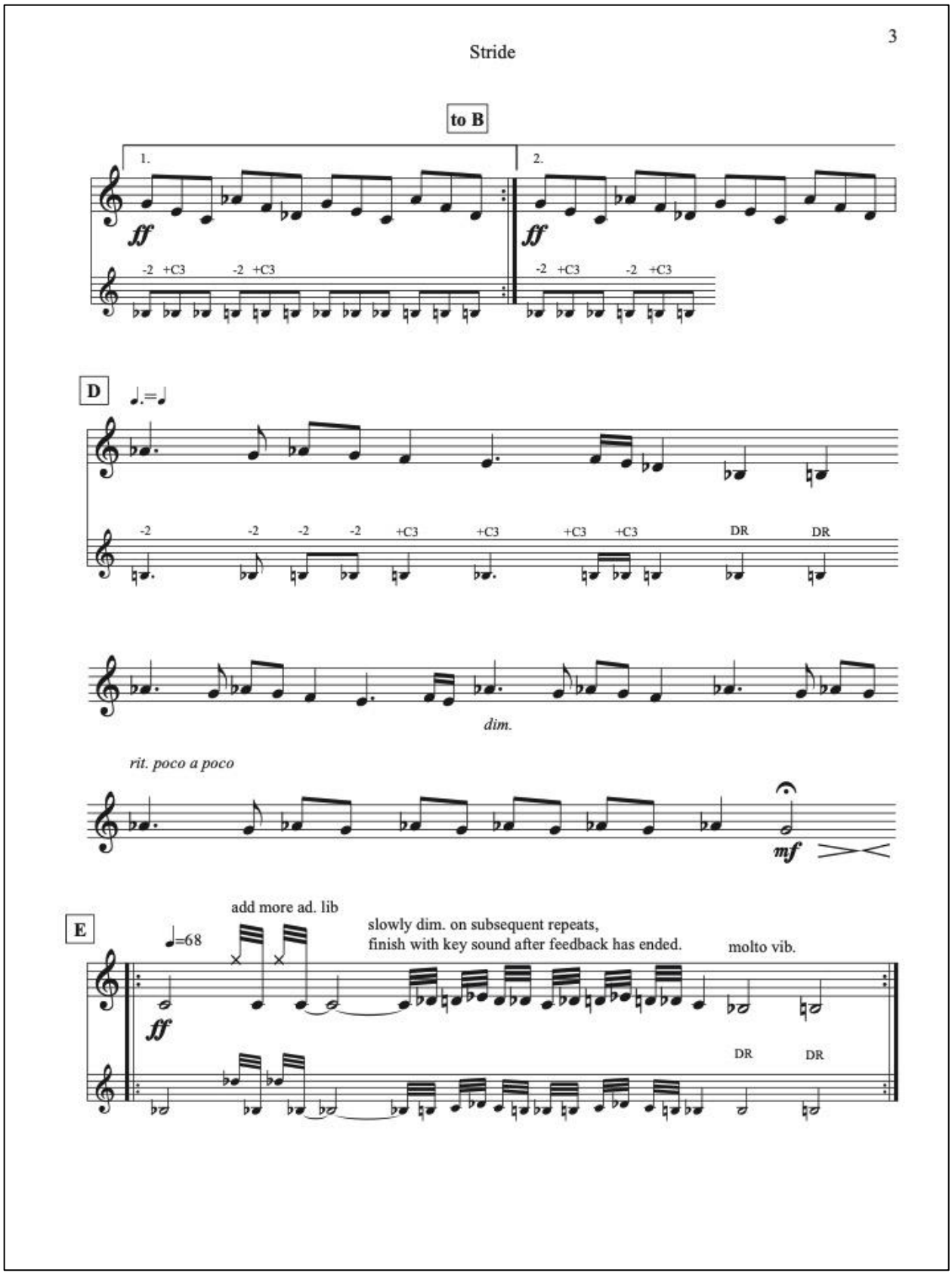
Stride

Greg Bruce

for feedback tenor saxophone




B - PICK & CHOOSE
REPEAT AD. LIB.
~3:00 & ~4:00
♩.=126
+C3-2
+C3 -2
+C3-2
+C3 -2
DR-C3 -2+C3
+C3 -2+C3
+C3 +C3 -2 -2 -2 +C3 +C3
C
(~3:00 and 4:00)
accel.
mp cresc.
mf cresc.
-2 +C3
-2 +C3


3
Stride
to B
1.
2.
ff
ff
-2 +C3 -2 +C3
-2 +C3 -2 +C3
D
♩.=♩
-2 -2 -2 -2 +C3 +C3 +C3 +C3 DR DR
dim.
rit. poco a poco
mf
E
add more ad. lib
♩=68
slowly dim. on subsequent repeats,
finish with key sound after feedback has ended.
molto vib.
ff
DR DR

Appendix 2: Score for *Doina*

D O I N A

For Feedback Tenor Saxophone

Greg Bruce 2021

~4:00

Greg Bruce

Doina

for feedback tenor saxophone

2021

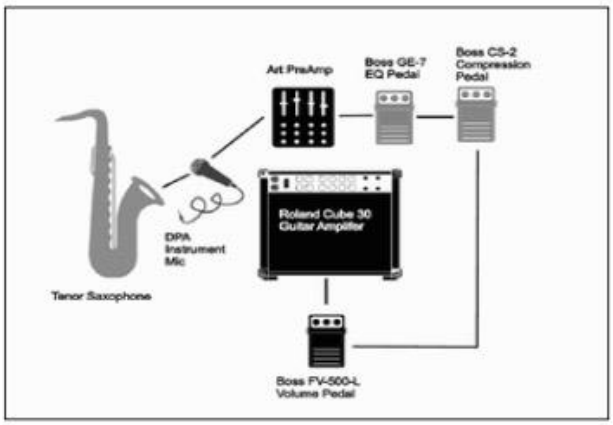
Equipment and Setup Instructions

This is Etude No. 2 for the original feedback saxophone system that I developed during my doctoral studies at the University of Toronto. This piece combines saxophone-controlled feedback with conventional playing.

Equipment

- DPA 4060 Instrument mic
- Art Preamplifier (for phantom power)
- Boss GE-7 Pedal
- Boss CS-3 Compression Pedal
- Boss FV-50L Volume Pedal (or 500L)
- Roland CUBE 30 COSM or Behringer GM-108 Amplifier
- Stool (barstool height) or table for amplifier
- Power Bar
- 9V Power Supply with Daisy Chain
- Min. two short ¼" unbalanced patch cables
- Min. two 6' ¼" unbalanced patch cables

Setup



- I *strongly* encourage the use of earplugs when first learning this system.
- The amp should be sitting on a table or stool that is waist high.
- The volume pedal must be on the floor, near the amp. The other pedals can be wherever is convenient.
- The performer should be facing the amp with their right side towards the audience and the bell of the tenor saxophone nearly touching the grill covering the speaker.
- The microphone must be deep in the bell of the instrument. Use a piece of tape or saxophone mute to ensure it stays in place.

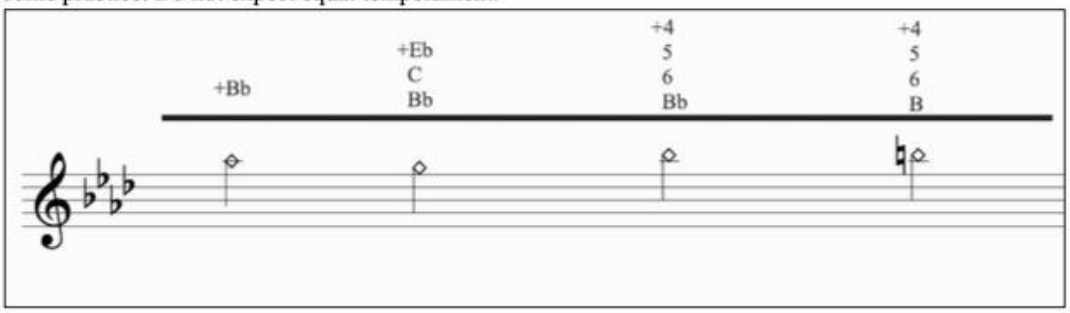
- The ART preamp is used to give phantom power to the DPA mic and allows for fine tuning the gain, a different preamp or even mixer could be used – though they may affect the tuning of the feedback notes.
- While other pedals may work, those listed will allow you to interpret the piece as accurately as possible. These are the rough settings for these pedals – you will likely need to adjust depending on the room, the saxophone, etc.

- Always start your practice sessions with the amplifier off and the volume pedal heel down.
- Turn on the compression and EQ pedals, followed by the amp, and then slowly angle the toe downwards on the volume pedal until you hear feedback.
- Feedback is created without blowing into the instrument and will be combined with conventional operation of the saxophone.

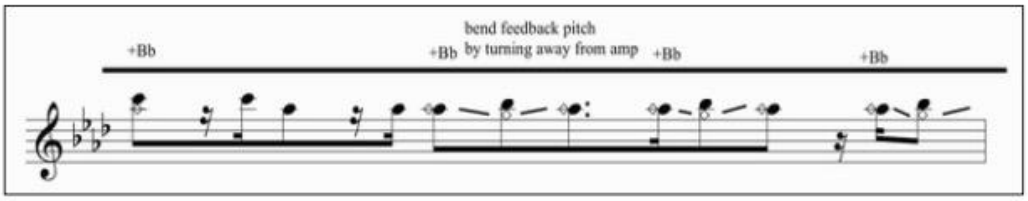
Notation

This is a transposing performance score, written for Bb tenor saxophone.

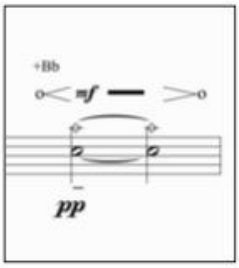
This piece is centred around the following feedback pitches and their required fingerings. You may discover more convenient key combinations to create these pitches. You will have to finely adjust the EQ between the amplifier, EQ pedal, and compression pedal to get these pitches to sound. This will take some practice. Do not expect equal temperament.



Above the staff will indicate what keys need to be added (eg. +Bb) to induce the feedback note, which is represented by a diamond notehead. The notation system for added keys use of the European/Londeix shorthand and are added in addition to any fingerings for conventional acoustic pitches.



The thick horizontal line indicates an ongoing feedback tone. Dynamics above the staff are for the feedback tone and are controlled with the volume pedal. Rests indicate breaks only for the conventional playing – brining the feedback tones in an out are represented by *niente* ("o") markings and are controlled by the volume pedal.



Contact

If you have any questions, please email me at:
gregthesquare@gmail.com

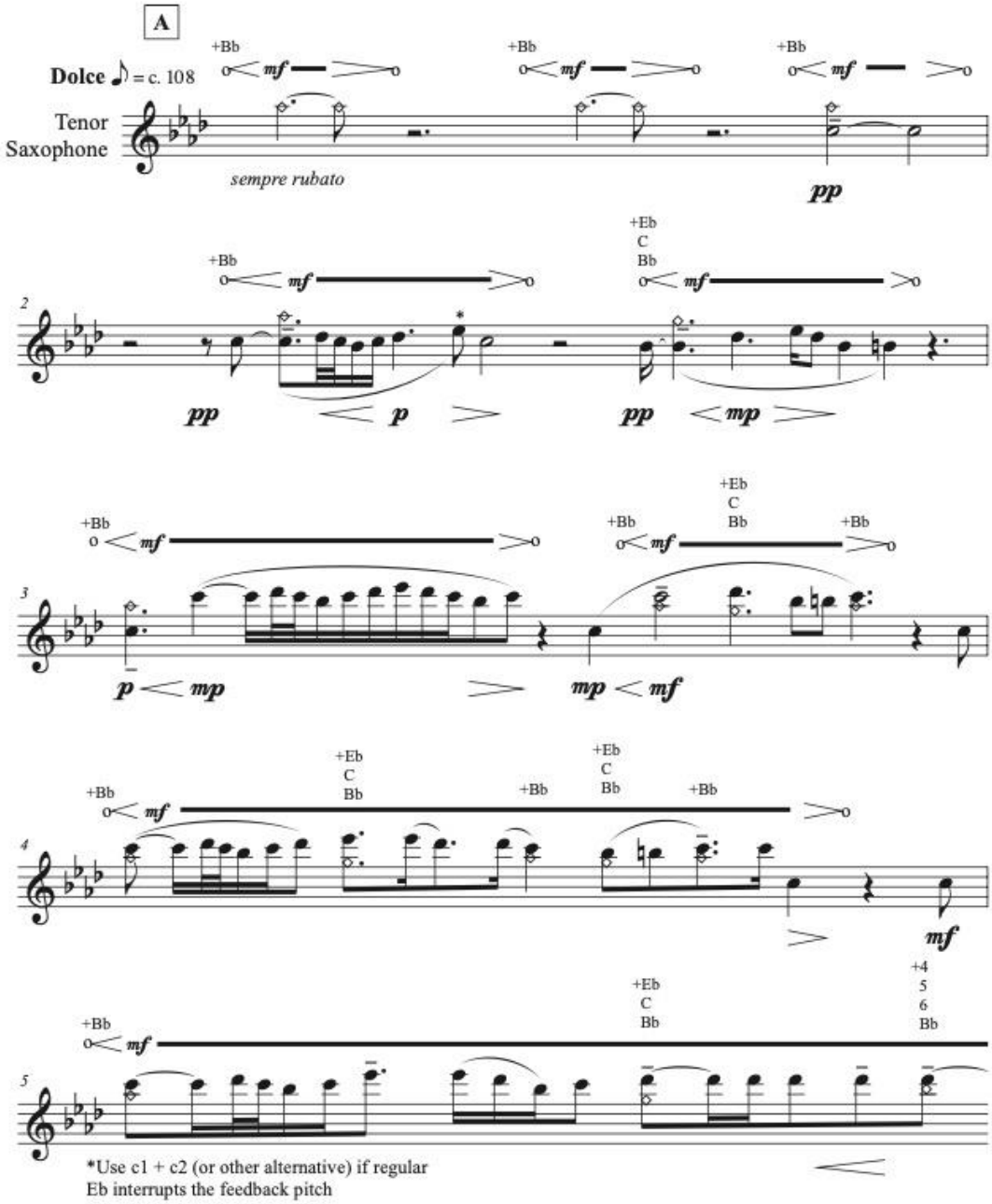
You can see performances of this piece and my other feedback works on my YouTube channel:
www.youtube.com/@gregthesquare4

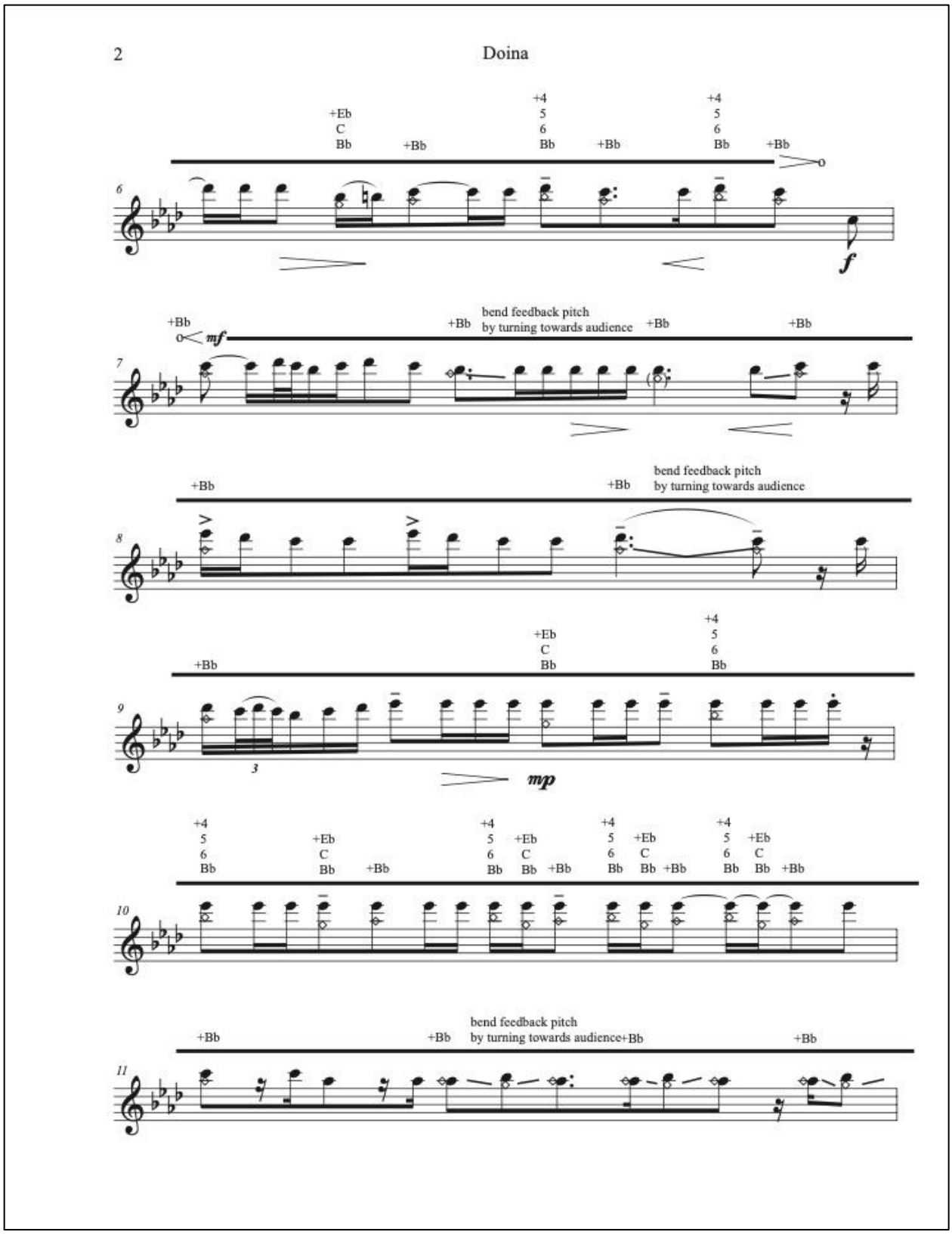
Bb Tenor Saxophone

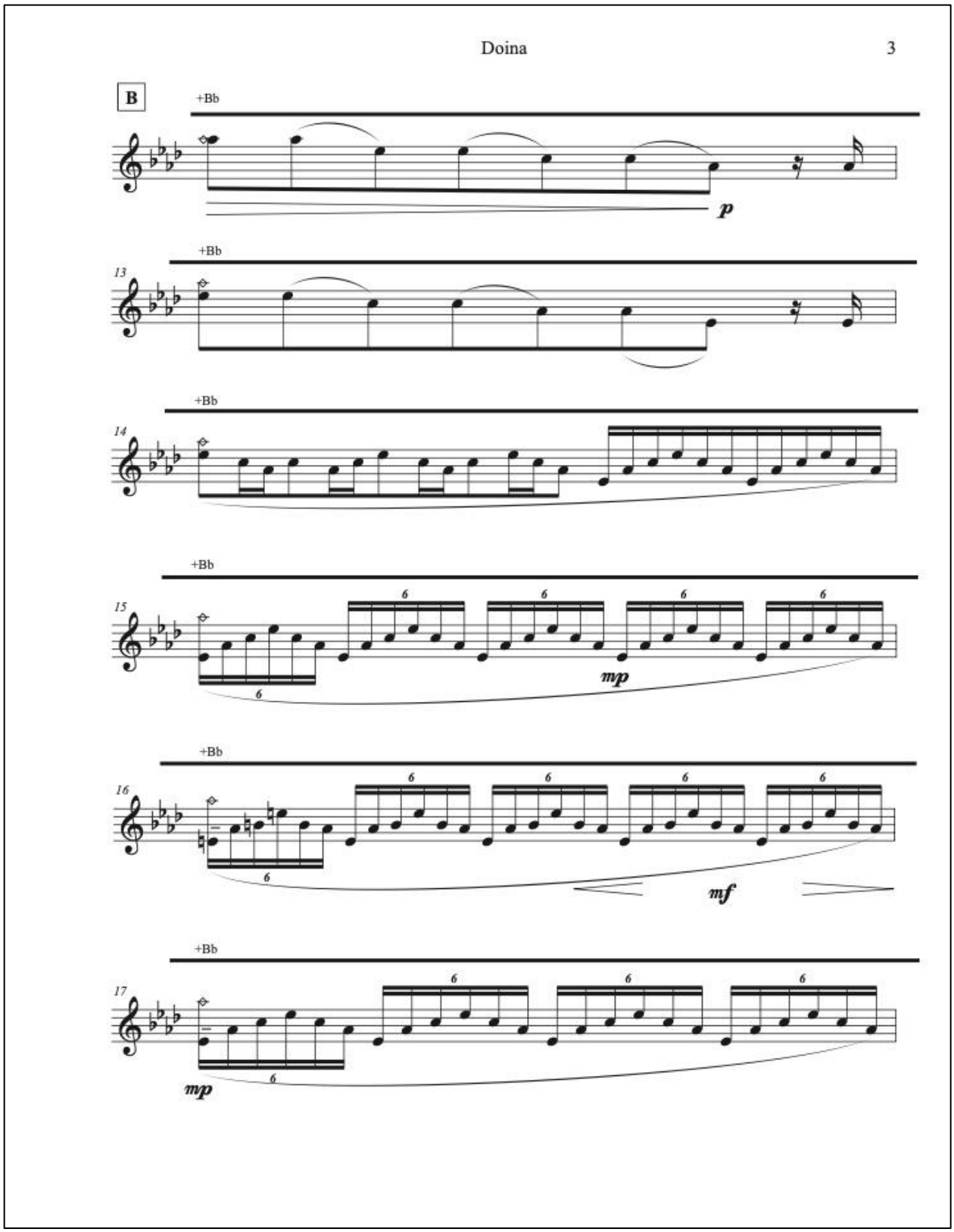
Doina

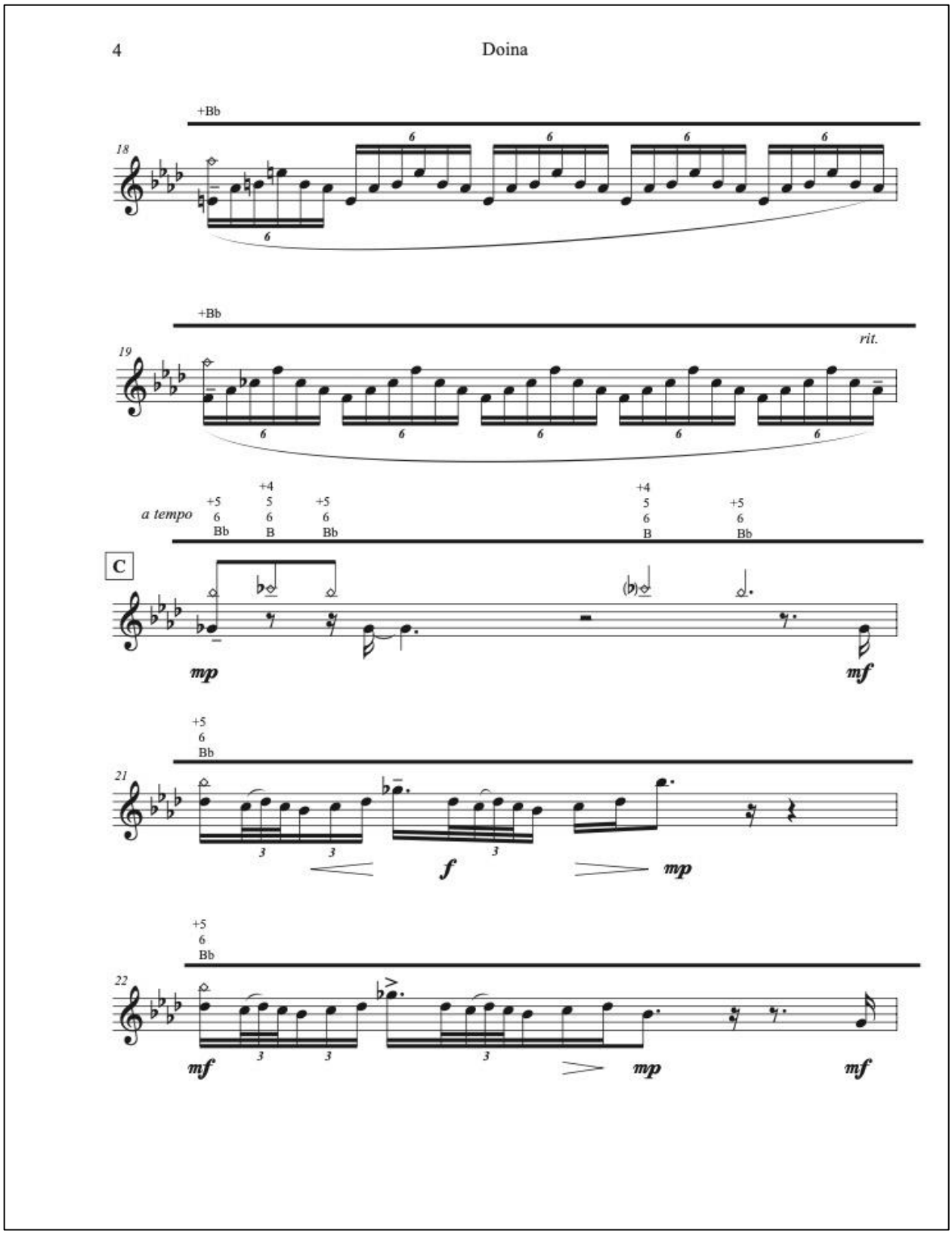
for feedback tenor saxophone

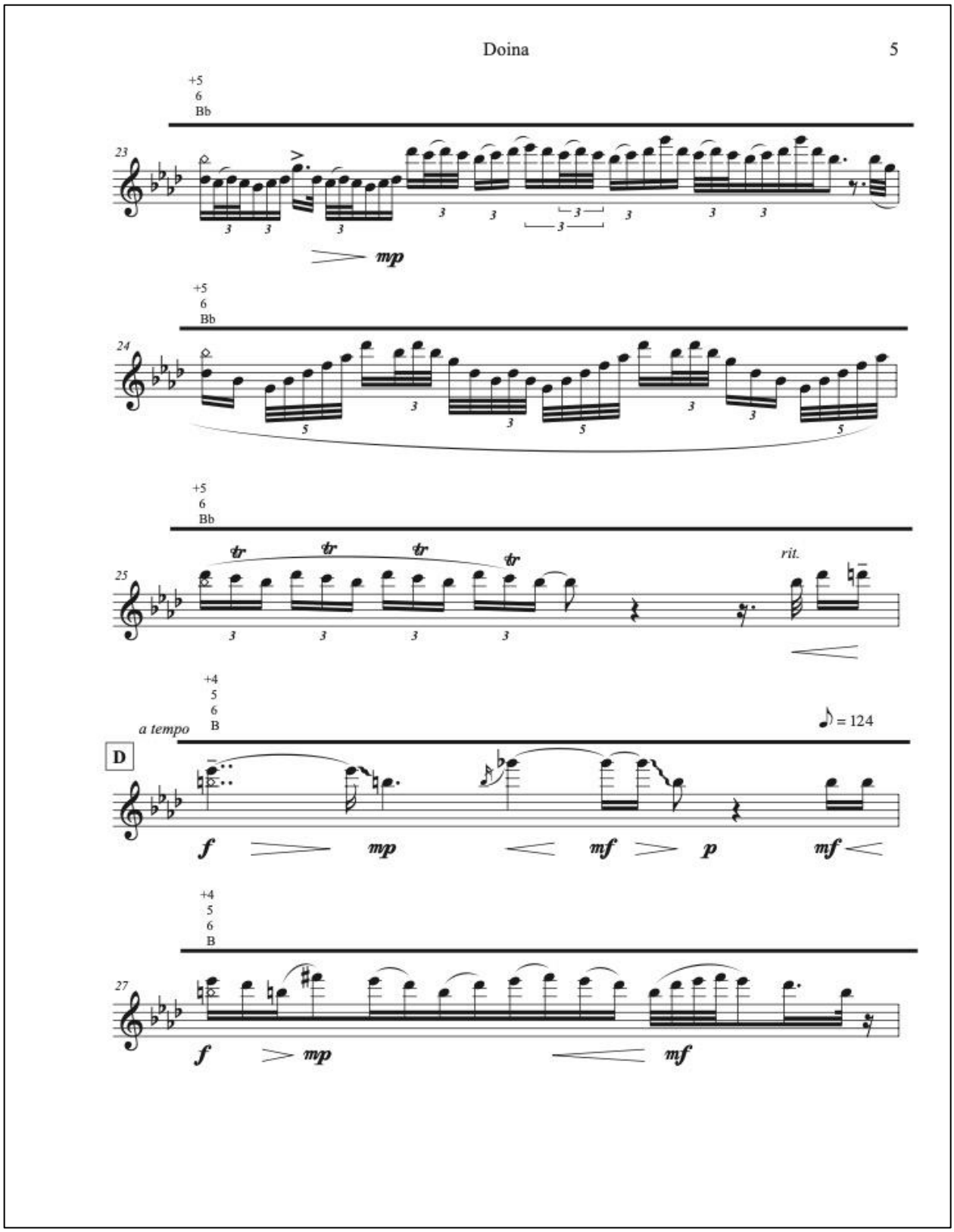
Greg Bruce

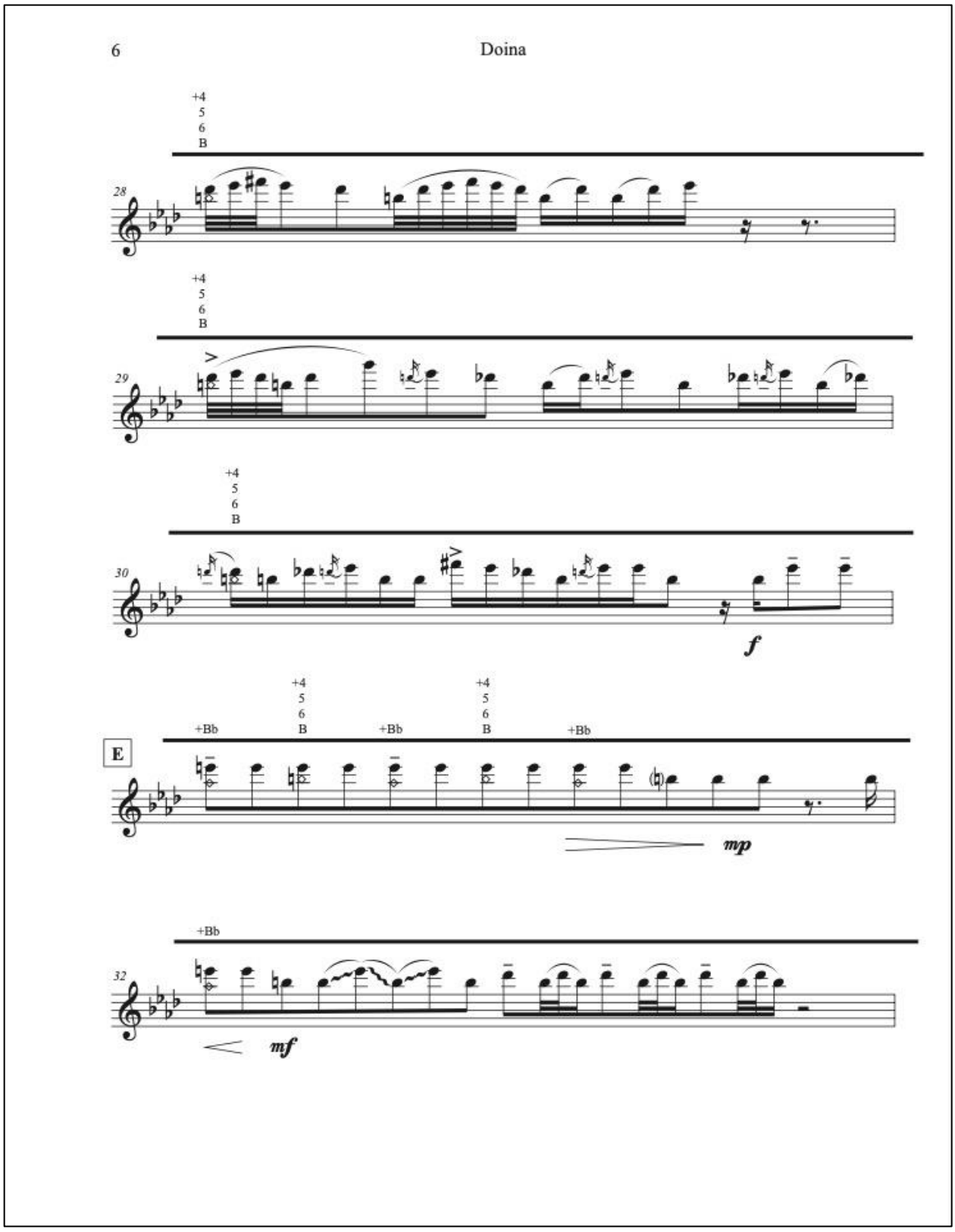


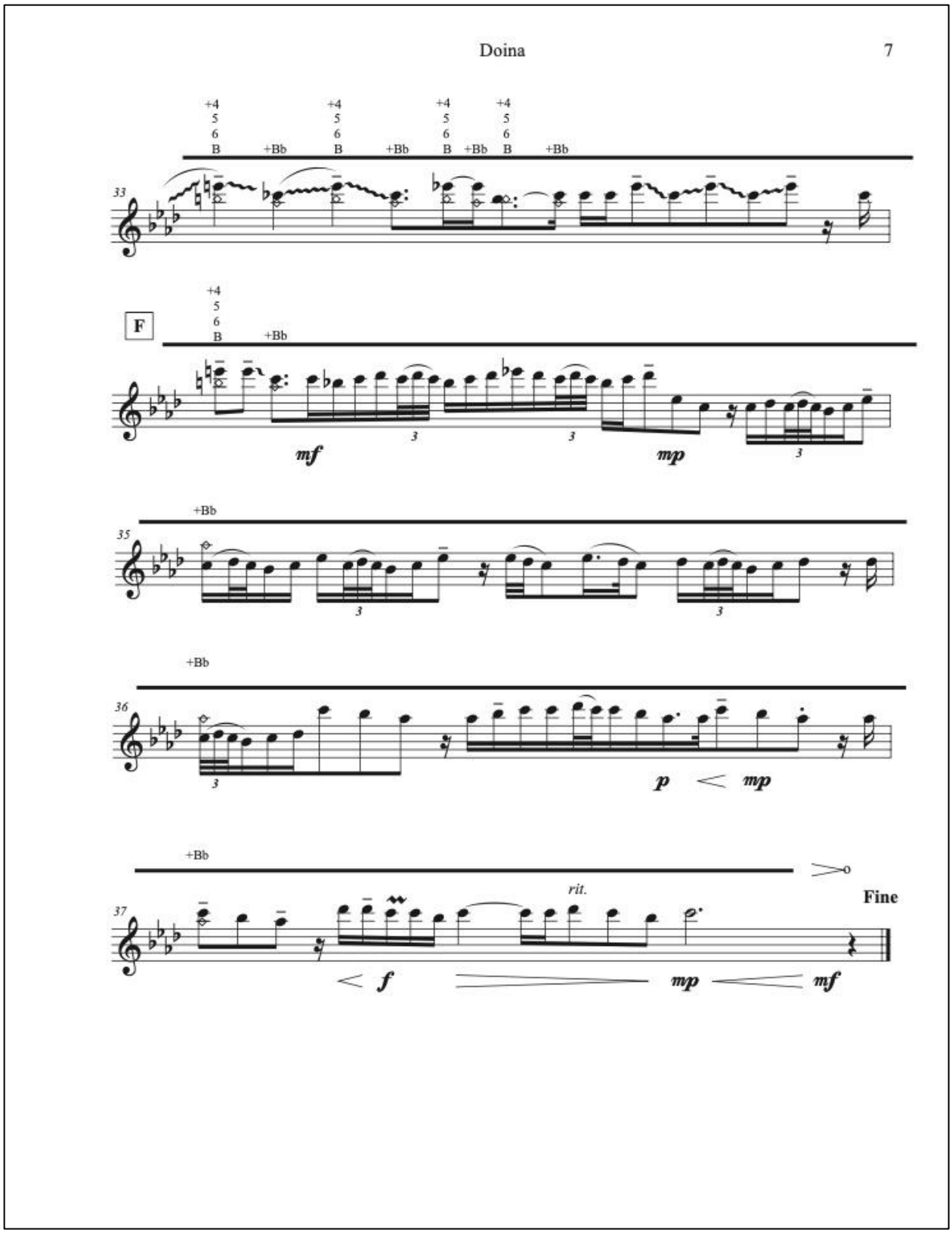

2
Doina
+Eb
C
Bb
+Bb
+4
5
6
Bb
+Bb
+4
5
6
Bb
+Bb
6
f
+Bb
mf
+Bb
bend feedback pitch
by turning towards audience
+Bb
+Bb
7
+Bb
+Bb
bend feedback pitch
by turning towards audience
8
+Bb
+Eb
C
Bb
+4
5
6
Bb
9
3
mp
+4
5
6
Bb
+Eb
C
Bb
+Bb
10
+Bb
+Bb
bend feedback pitch
by turning towards audience
+Bb
+Bb
11


Doina
3
B
+Bb
p
+Bb
13
+Bb
14
+Bb
15
6
mp
+Bb
16
6
mf
+Bb
17
6
mp


4
Doina
+Bb
18
+Bb
19
rit.
a tempo
+5
6
Bb
+4
5
6
B
+5
6
Bb
+4
5
6
B
+5
6
Bb
C
mp
mf
+5
6
Bb
21
f
mp
+5
6
Bb
22
mf
mp
mf


Doina
5
+5
6
Bb
23
mp
+5
6
Bb
24
+5
6
Bb
25
tr
tr
tr
tr
rit.
+4
5
6
B
a tempo
D
♪ = 124
f
mp
mf
p
mf
+4
5
6
B
27
f
mp
mf


6
Doina
+4
5
6
B
28
+4
5
6
B
29
+4
5
6
B
30
f
+4
5
6
B
+Bb
+Bb
+4
5
6
B
+Bb
E
mp
+Bb
32
mf


Doina
7
+4
5
6
B
+Bb
33
F
mf
mp
35
36
p
mp
rit.
37
Fine
f
mp
mf

Appendix 3: Score for *Yen*

Y E N

For Feedback Tenor Saxophone

Greg Bruce 2022

~5:00

Greg Bruce

YEN

for feedback tenor saxophone

2022

Equipment and Setup Instructions

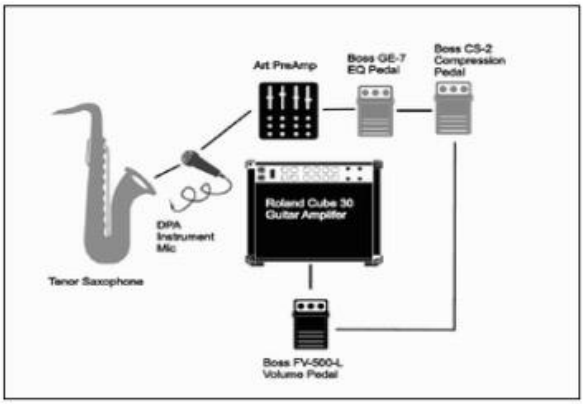
This is Etude No. 3 for the original feedback saxophone system that I developed during my doctoral studies at the University of Toronto. This piece combines saxophone-controlled feedback, conventional playing, and vocalization.

Yen (noun): a strong desire or propensity \ \ a yen to be heard.

Equipment

- DPA 4060 Instrument mic
- Art Preamplifier
- Boss GE-7 Pedal
- Boss CS-3 Compression Pedal
- Boss FV-50L Volume Pedal (or 500L)
- Roland CUBE 30 COSM or Behringer GM-108 Amplifier
- Stool (barstool height) or table for amplifier
- Power Bar
- 9V Power Supply with Daisy Chain
- Min. two short ¼" unbalanced patch cables
- Min. two 6' ¼" unbalanced patch cables
- Contact Mic, such as the AKG C411 (a cheap one from amazon will also work)
- Collar, chocker, or narrow piece of fabric (for affixing the contact mic to your neck)

Setup – feedback sax



- I *strongly* encourage the use of earplugs when first learning this system.
- The amp should be sitting on a table or stool that is waist high.
- The volume pedal must be on the floor, near the amp. The other pedals can be wherever is convenient.
- The performer should be facing the amp with their right side towards the audience and the bell of the tenor saxophone nearly touching the grill covering the speaker.
- The microphone must be deep in the bell of the instrument. Use a piece of tape or saxophone mute to ensure it stays in place.
- The ART preamp is used to give phantom power to the DPA mic and allows for fine tuning the gain, a different preamp or even mixer could be used – though they may affect the tuning of the feedback notes.
- While other pedals may work, those listed will allow you to interpret the piece as accurately as possible. These are the rough settings for these pedals – you will likely need to adjust depending on the room, the saxophone, etc.

- Always start your practice sessions with the amplifier off and the volume pedal heel down.
- Turn on the compression and EQ pedals, followed by the amp, and then slowly angle the toe downwards on the volume pedal until you hear feedback.
- Feedback is created without blowing into the instrument and will be combined with conventional operation of the saxophone.

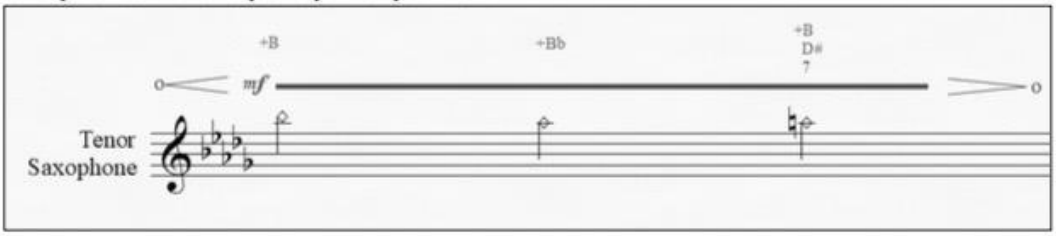
Setup – throat mic

- Affix the contact mic to the front of your throat by way of a piece of fabric, choker, etc.
- If using a contact mic that requires phantom power, it will need to be run through an external mixer or the preamp (if using one with multiple inputs).
- Take the output from the preamp and send it either to the Roland Cube 30 AUX in or an external output.
- If running it through the feedback amplifier, you will have reduced dynamic range, but it will work.

Notation

This is a transposing performance score, written for Bb tenor saxophone.

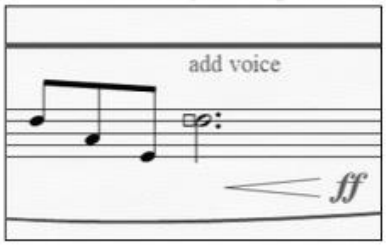
This piece is centred around the following feedback pitches and their required fingerings. You may discover more convenient key combinations to create these pitches. You will have to finely adjust the EQ between the amplifier, EQ pedal, and compression pedal to get these pitches to sound. This will take some practice. Do not expect equal temperament.



Above the staff will indicate what keys need to be added (eg. +Bb) to induce the feedback note, which is represented by a diamond notehead. The notation system for added keys use of the European/Londeix shorthand and are added in addition to any fingerings for conventional acoustic pitches.

The thick horizontal line indicates an ongoing feedback tone. Dynamics above the staff are for the feedback tone and are controlled with the volume pedal. Rests indicate breaks only for the conventional playing – brining the feedback tones in an out are represented by *niente* ("o") markings and are controlled by the volume pedal.

The notes to be sang/yelled/hummed are indicated in the staff by a square notehead and should follow any dynamics below the staff. If the given note is below your range, choose any octave above.



Contact

If you have any questions, please email me at:
gregthesquare@gmail.com

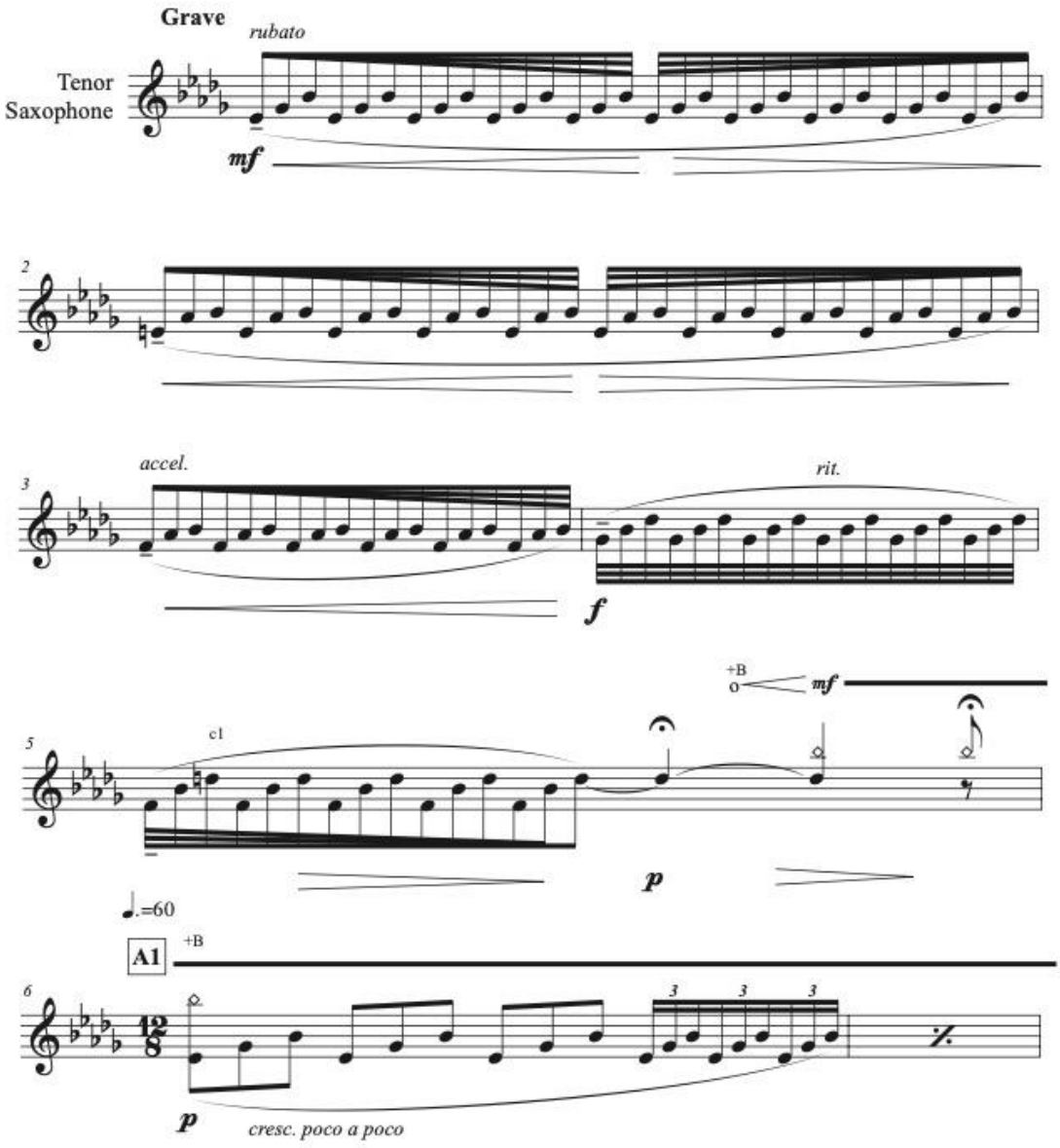
You can see performances of this piece and my other feedback works on my YouTube channel:
www.youtube.com/@gregthesquare4

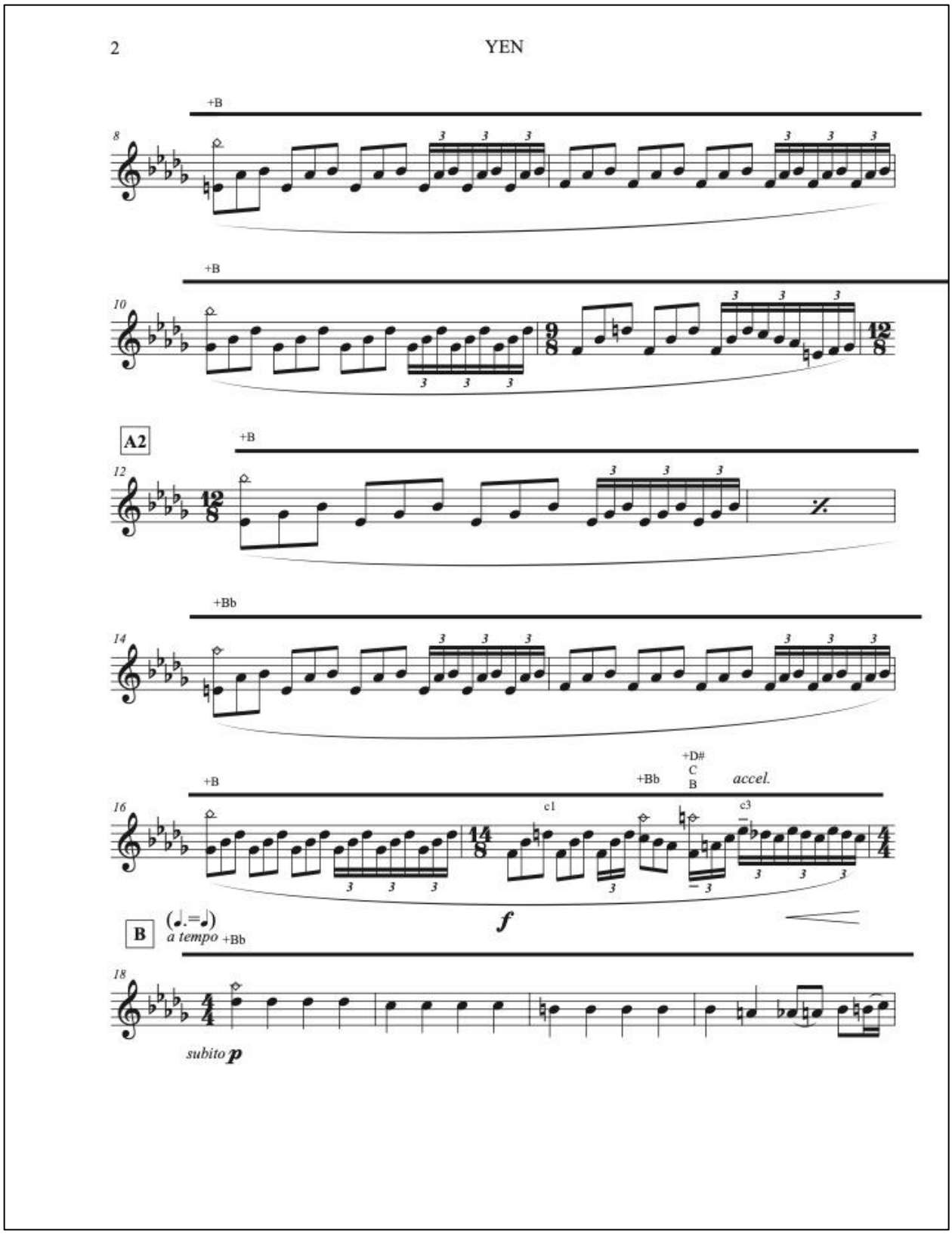
Bb Tenor Saxophone

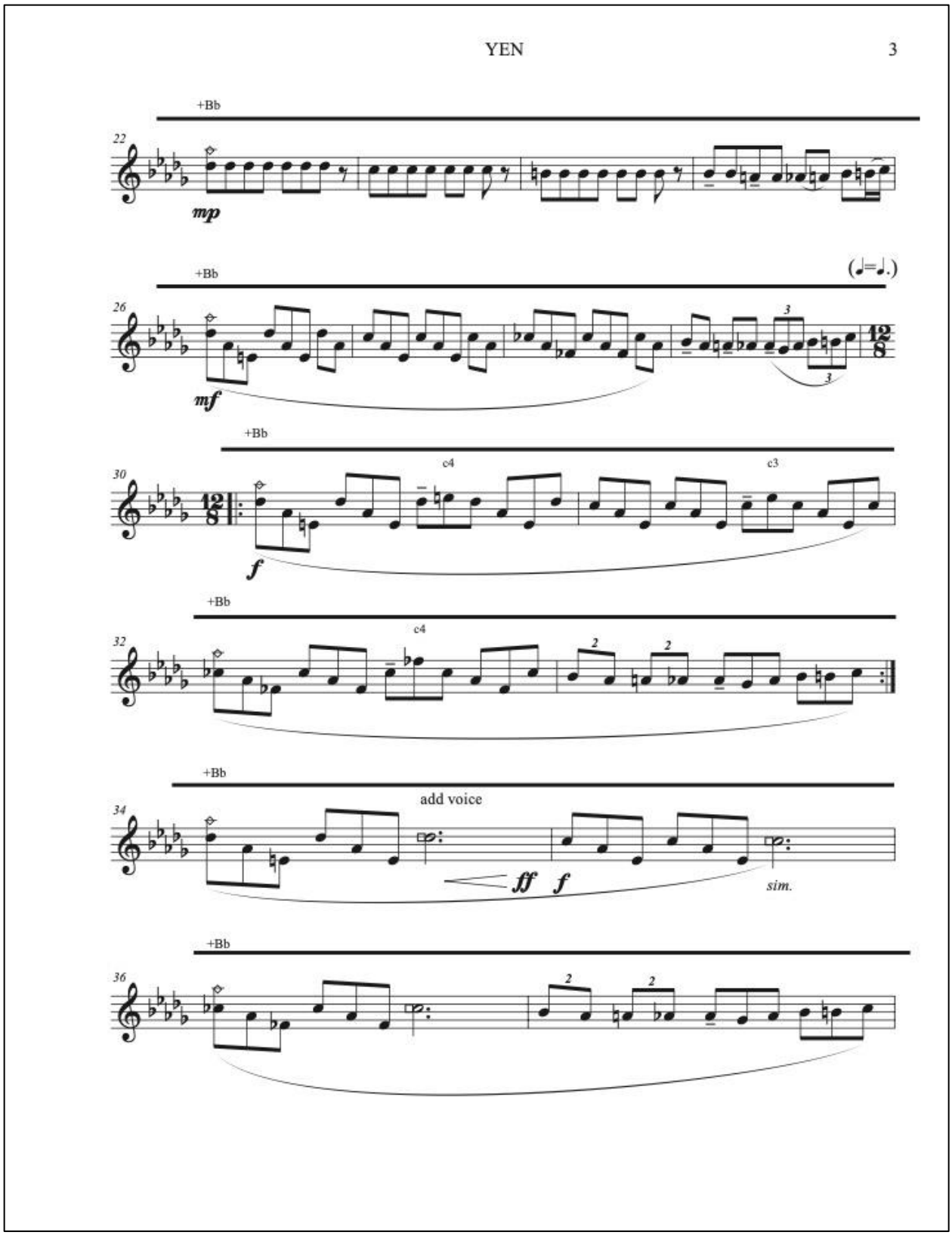
YEN

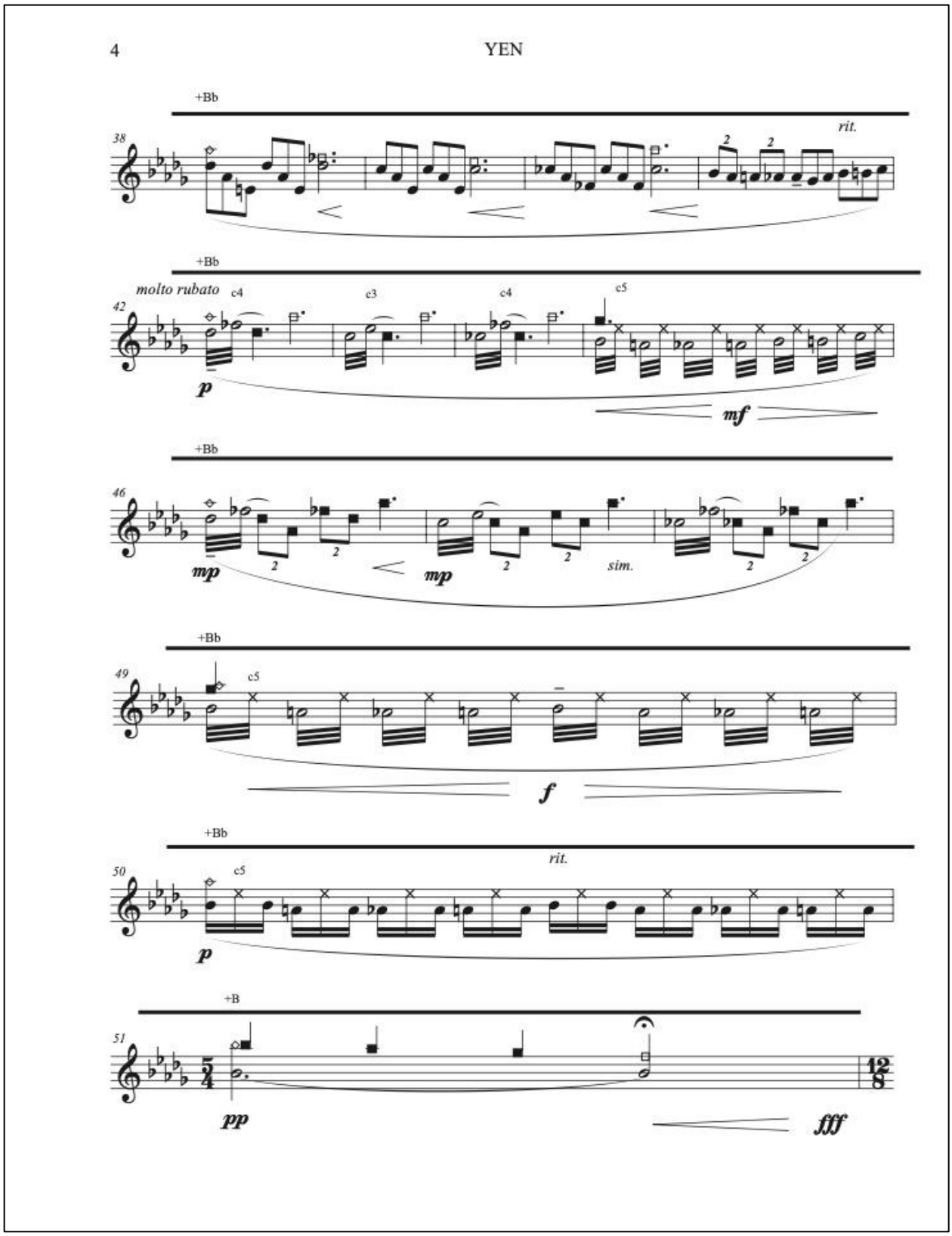
for feedback tenor saxophone

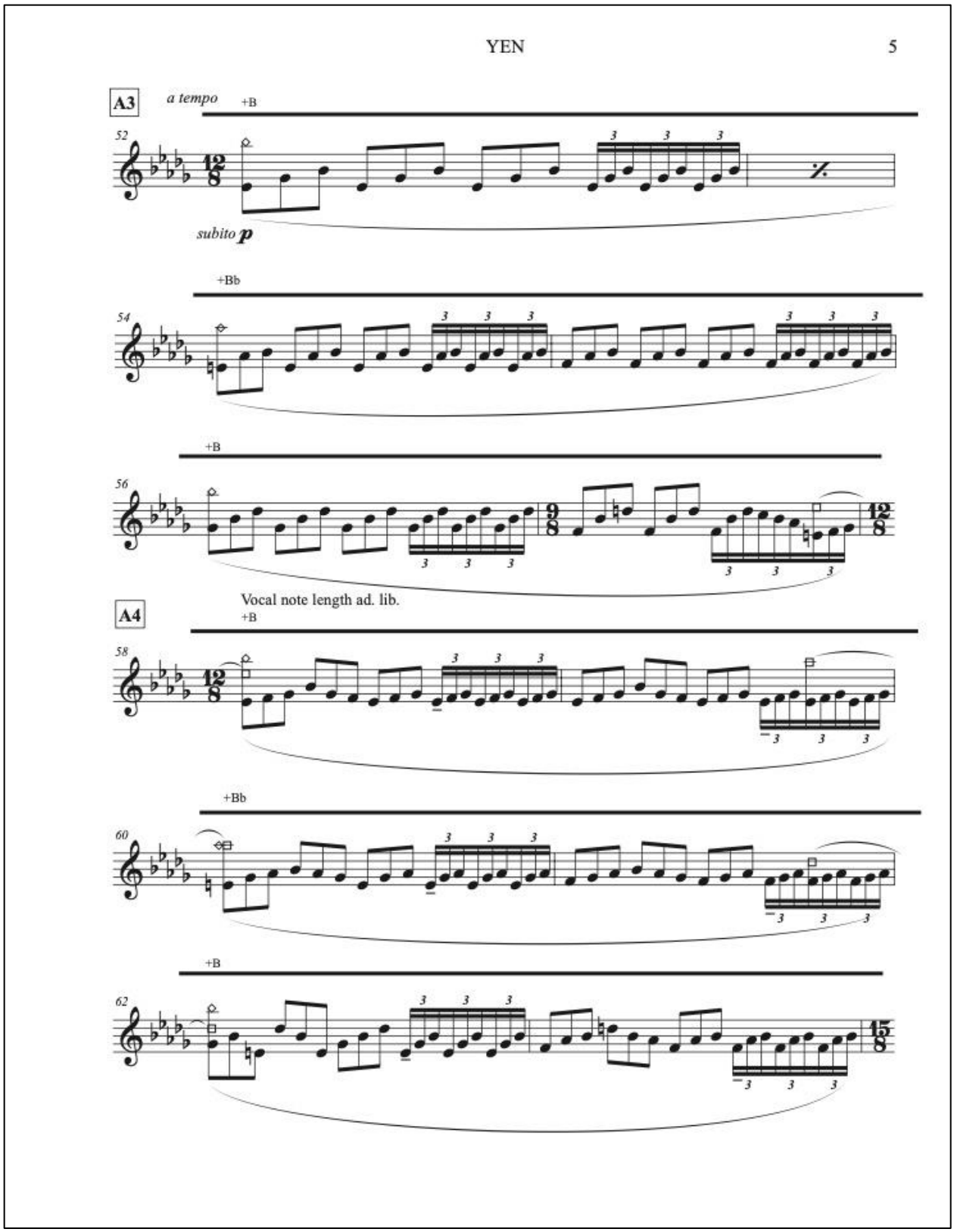
Greg Bruce

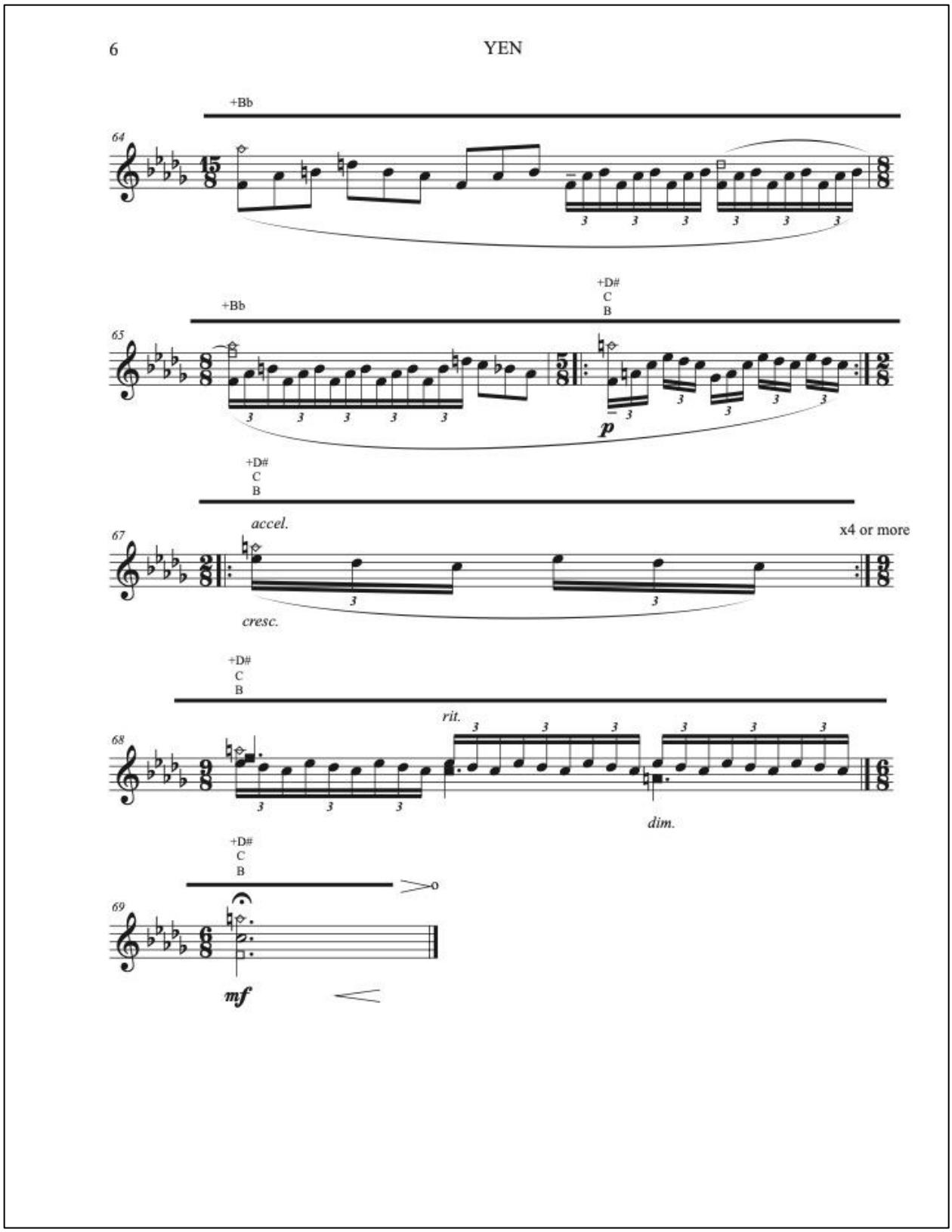



2
YEN
+B
8
+B
10
A2
+B
12
+Bb
14
+B
+Bb
+D#
C
B
accel.
16
c1
c3
f
B
(♩.=♩)
a tempo +Bb
18
subito p


YEN 3
+Bb
22
mp
+Bb
(♩=♩.)
26
mf
+Bb
30
c4
c3
f
+Bb
32
c4
+Bb
add voice
34
ff f
sim.
+Bb
36

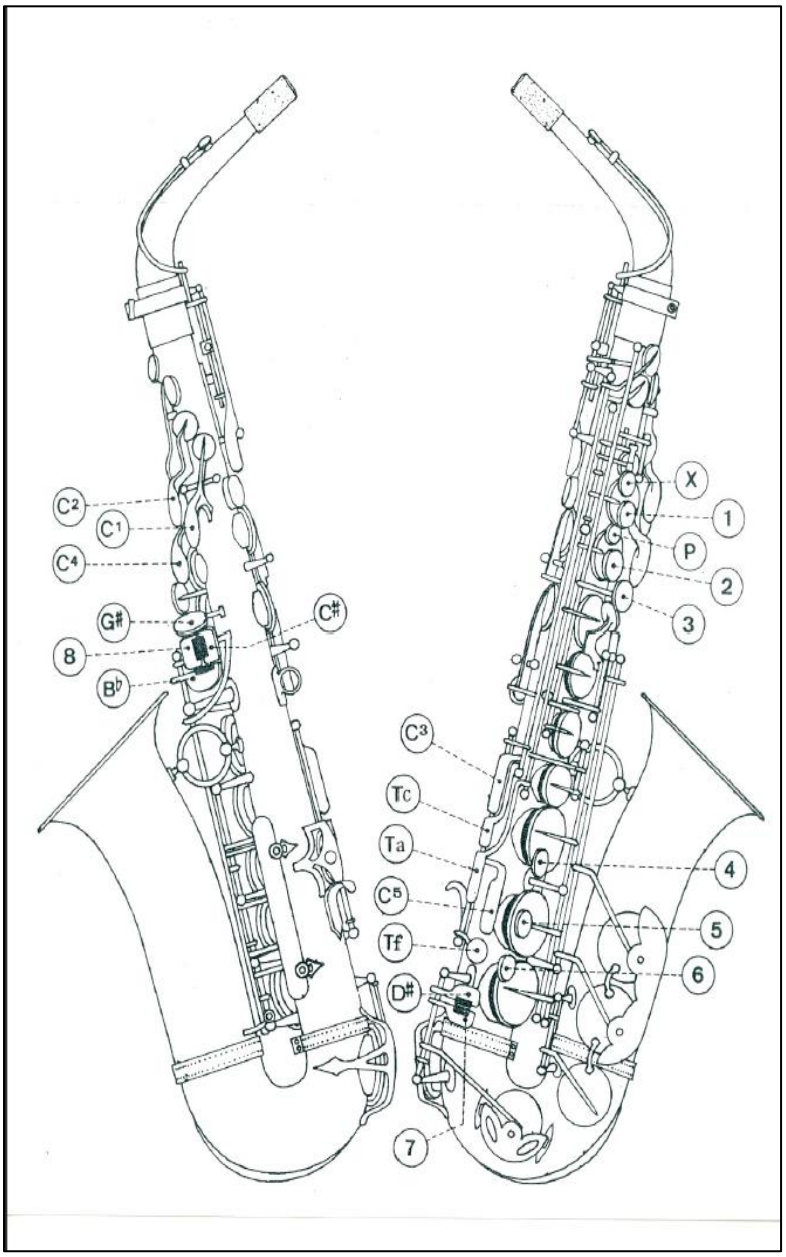

4
YEN
+Bb
38
rit.
+Bb
molto rubato
42
c4
c3
c4
c5
p
mf
+Bb
46
mp
mp
sim.
+Bb
49
c5
f
+Bb
rit.
50
c5
p
+B
51
pp
fff


YEN
5
A3
a tempo
+B
52
subito p
+Bb
54
+B
56
Vocal note length ad. lib.
A4
+B
58
+Bb
60
+B
62


6
YEN
+Bb
64
+Bb
+D#
C
B
65
p
+D#
C
B
accel.
67
x4 or more
cresc.
+D#
C
B
rit.
68
dim.
+D#
C
B
69
mf

Appendix 4: Londeix Fingering Chart

Londeix saxophone fingering system.[174] Since its development in the 1970s, it has evolved: "7" and "8" are no longer in use and instead referred to as "C" and "B" respectively. "D#" is also used interchangeably with "Eb."



[174] Jean-Marie Londeix, *Tablature des Doigtes compares des Notes suraigues*, (Paris, France: Alphonse Leduc, 1974).