Trading Conversations Between Science and Art: When Musical Improvisation Enters the Dialogue on Stage

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Abstract

Although the current societal push for Science-Art collaboration is loud and omnipresent, its integration and practice is superficial. Science and Art disciplines offer a wealth of methodologies, processes, and outcomes relevant to understanding the fundamentals of the how and why of our behaviors, but they remain disconnected in part due to an overwhelming lack of understanding that their solid integration offers invaluable insight for major questions within the study of human cognition. In this paper I argue for a shift in perspective for empirical work in human cognition that genuinely combines and transforms elements from Science and Art to create (a) a new, hybrid discipline as well as (b) sets of new data from which to extract meaningful patterns. I specifically focus on applying integrative Science-Art investigation towards such questions as the relationship between music and language, emotion expression, and spontaneous, real-time adaptability in live, artistic contexts. I discuss a novel project within theatre with live musical improvisation to dissect the characteristics of a coherent, dramatic conversation.

Introduction

In a moment in history when such concepts as interdisciplinarity, creativity, and innovation repeatedly permeate academic, cultural, and social discourse with loose effect, I cannot but hear the inevitable call back for Science-Art relevancy, acceptance, and veritable integration. As stated in 2015 by the head of the School of Design at Carnegie Mellon, "education has become so siloed that we can no longer connect the dots that need to be connected in order to address problems."[1] The result is a crisis in overall societal problem solving. This intellectual regression is bizarre. History has examples of successful transdisciplinary Science-Art thinkers and innovators whose revolutionary ideas and inventions continue to influence modern thought in a variety of domains (from Ismail al-Jazari to Leonardo da Vinci to Arthur Conan Doyle, among others). And such areas as architecture, cinema, design, and fashion have depended on the fundamental integration of Science and Art. Moreover, there are more similarities between the disciplines than dissimilarities and there is no shortage of comments from forward-thinking individuals on such. Two statements from two fascinating minds of the twentieth century stand out for honing in on the intersecting nature of Science and Art: "After a certain high level of technical skill is achieved, science and art tend to coalesce in esthetics, plasticity, and form. The greatest scientists are always artists as well,"[2] remarked Albert Einstein, and "…It seems to me that such phenomena [referring to the paranoia arising from an artist willfully submitting to the associative power of the psyche], comprising just as violent determinations of choice, cannot be in vain, and cannot, to a more or less marked degree, fail to intervene in what for me is this conditional factor of scientific experimentation, and which, to use the same terms as E. Schrödinger, consists in 'the momentary disposition of our interest

and of its determining influence in the direction of subsequent work,"[3] as Salvador Dalí wrote in *The Tragic Myth of the Angelus by Millet* in 1932/33 to underscore the fundamental arbitrary nature of both objectivity and subjectivity. Masters of the Science and Art worlds, respectively, they independently speak to each world's commonalities regarding expression and outcome and experimentation and process. In spite of their commonalities the disciplines remain fundamentally divided within broader academic and cultural circles, preventing the seamless merging of disciplines and the establishment of sustainable hybrid forms of Science-Art practice, communication and public engagement. The theoretical divide the two disciplines stand on is, although vibrant, in essence, elusive and false and hampering creativity and innovation. In fact, the divide is downright evolutionarily nonsensical – our capacity for finding patterns and building relationships amongst the various elements in our environment and the consequent ingenuity is the result of evolution and we are experts at using such cognitive abilities. Although in the context of the wonder of science and observation, Carl Sagan says it most eloquently: "The secret of our success is surely our curiosity, our intelligence, our manipulative abilities, and our passion for exploration – qualities that have been extracted painfully through billions of years of biological evolution. It is in the nature of mankind and the corollary of our success to ask and answer questions, and the deeper the question the more characteristically human is the activity."[4]

And it is with this mindset to search for and entertain the deeper question that I appeal for a significant change once and for all in the study of human cognition: to understand the fundamental processes of human real-time adaptability, both its efficiency and speed, an acceptance of the multisensory complexity of real-world situations must be brazenly implemented within empirical work and not ignored. This implementation, I argue, requires a revision and integration of the scientific and artistic methods. As a trained and practicing cognitive scientist and as a trained and practicing multidisciplinary artist within the visual and performing arts I will discuss the interdisciplinary Science-Art approach needed, and the results acquired from such an approach, to the cognitive psychological study of creative thinking, conversational aesthetics, and improvisatory, interactive audiovisual perception and cognition within live theatre.

Definitions

To integrate disciplines, one must first comprehend their ways. And to understand a possible origin of dissent between the Science and Art fields of study and practice, particularly as it pertains to the study of the mind/brain, it is necessary to break down their methods and their outcomes. I begin, therefore, with detailed clarifications originally introduced in López-González (2015).[5]

Science

Science, by virtue of its intent to decipher and explain the natural, physical, and social world requires, in a general sense,

reductionism and control –a perspective initially formalized during the Enlightenment in the 18th century. Fundamentally inspired by curiosity and driven by imagination, much of its overall method relies on the following set of ordered steps: establishing the main topic of interest, posing question or hypothesis x, picking contrasting variables y and z and a control, testing in a laboratory space –in as close as possible the same exact way every iteration– the object in question against conditions a and b, analyzing observed behavior c to determine if obtained result supports previous claims about question or hypothesis x, and repeating for reproducibility and validity. Numbers represent core observations: either n subjects have x reaction times, or n subjects share some y effect, or n subjects exhibit some z condition, etc. Consequent results either verify or refute the hypothesis, or simply offer an entirely new possibility not previously entertained for which further experiments (i.e. conditions/situations) are developed to characterize the reason(s) for such unexpected outcome(s). Those numbers then undergo complex strategies of manipulation for consistent statistical significance to report observations as uniformly occurring above chance under the tested conditions. Progress in scientific investigation relies on the continuous building upon observations to eventually construct a unified theory that has both specific and generalizable applicability regarding the domain of study. And as Sir Humphry Davy remarked about the role of curiosity in scientific discovery, "…the pleasure is even greater when we know the laws which govern it [the thing being studied]. Thus the study of nature and its various laws must, to a certain extent, always be bound to the love of the beautiful and the sublime."[6] This methodological system, however rigid it can be, is not devoid of trial-and-error situations and creative maneuvering. In fact, proposing a hypothesis and devising an experiment to test said hypothesis alone and being at the forefront of scientific inquiry requires "…a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination," (p. 109)[7] as remarked by Max Planck on the qualities of a pioneering scientist and with which I enthusiastically agree and advocate for. Further stated, being a truly innovative scientist *is* an art form itself that requires structured time-tested abcs and unexpected, ever evolving choices.

Art

Art, on the other hand, by virtue of its general intent to question, respond to, debate, mimic, and represent the natural, physical, and social world requires antireductionism and spontaneity. Fundamentally inspired by curiosity and driven by imagination, much of its overall method –which is open to reordering at any given moment– relies on identifying a particular emotional or conceptual problem (or set of problems), posing question x or establishing a desired effect (which can change at any moment, and that change can influence the subsequent direction of inquiry), choosing variables x and y to explore, preparing materials (environment can be –and at times *must* be– lenient given changing creative spaces), testing possibilities to see what emerges or until desired effect is achieved (which can change at any moment), and repeating (with alterations) for variations and new effects. With respect to outcomes, we find a similar set of superficial differences yet fundamental similarities to Science. In Art, instead of numbers, contexts tend to represent particular objectives. Depending on the particular art form in question, either x examples have a colors, or x examples function with b lighting, or x examples challenge c words, or x examples influence d space(s), etc. The resulting artwork either verifies or refutes the hypothesis (or question or emotion at hand), or simply offers an entirely new possibility not previously entertained and for which possible further experiments (i.e. conditions/situations) are developed to breakdown or increase such unexpected outcome(s). Those contexts then undergo complex strategies of manipulation for consistent, narrative novelty. Given the vast array of possible human experiences, and their consequent representations, artistic progress tends towards the mastery of one or many techniques and novelty of representation. I further state that the elasticity of method described can also be strict and linear. A certain level of tedious and repetitive drafting, step-by-step building and redesigning of a single concept even is, at times, the *only* impetus to a novel idea – core process elements typically associated with scientific discovery. And the imitable fashion designer and draping pioneer Madeleine Vionnet remarks similarly about her grueling creative artistic process: "…I believe that all research is arduous and almost always frustrating. A true creation must necessarily and naturally be laborious. She who attempts to create must suffer." (p. 59)[8] Further stated, being a truly innovative artist *is* a science in itself that requires unexpected, ever evolving choices and structured time-tested abcs.

Science-Art

Ultimately, whether reproducibility or irreproducibility, or numbers or contexts, both disciplines share the same overarching goals: find and establish new patterns so models, theories, and representations can be made about the phenomenon that *is* the human condition. Furthermore, both disciplines depend on a mix of linear procedure and open-ended tweaking and imagination to reach those goals with neither element reducible to exact percentage amounts in either discipline. With both disciplines equal in process, endeavor, and result, one discipline is not socially or economically worth more or less than the other and most certainly not "harder/more rigorous" or "softer/airier" than the other, as has been ignorantly professed for far too long in some circles.

So why so many degrees of separation between the two disciplines…to the point of almost rivalry in some cases!? Because societal norms, institutional structures, and cultural expectations, among other things, have over time erroneously proliferated the idea that the Sciences and the Arts are vastly different with regards to study, process, practice, outcome, presentation, purpose, justification, and value. I summarize general methods and outcomes based on first-hand experience and years of collected observations within the very separated academic and cultural worlds of cognitive science, neuroscience, psychology, and philosophy of mind as a researcher, experimenter, and theorist, and within the music, photographic, film, and theatre worlds as a musician, photographer, writer, filmmaker, director, and actress. I further note that there are even more barriers *within* the Sciences and *within* the Arts that are beyond the scope of this paper and will not be addressed. Yet I cannot stress enough how ridiculous the barriers placed within and between disciplines can be!

As ultimate hypothesis testing, truth searching, conflict resolving (or creating), imperfect, and most harmonious of disciplines, Science and Art should grow hand-in-hand, not as antagonistic silos on opposite ends of a continuum –an all too detrimental academic reality that needs to end now! And when it comes to studying creative behavior within artistic contexts –the yet intangible mental processes that lead to novelty, non-obviousness, utility, and an aesthetic experience– Science and Art must re-intersect if the process is to be fully understood and modeled beyond simple, problem-solving tasks repetitive in behavior and meaningless in content. Because yes, from direct

personal experience, creative moments are filled with just as much intent and structure as emotion, uncertainty and randomness and are not simplified, single, and immediate go-stop-go miniature moments as are often imposed in a laboratory setting (e.g. "improvise a new melody every time you hear the single-beep cue which will be randomized among the double-beep cue to play a basic chromatic scale. Each condition is one minute long," as proceed typical instructions to participating professional musician artists during a creative vs. non-creative-testing experiment). Armed with knowledge of such, one must be unafraid to break with traditional norms within the generally accepted and followed "rigidity" of the scientific process and the generally accepted and followed "flexibility" of the artistic method and essentially combine and transform elements from the two to create a new, hybrid discipline and what I formally and publically began in 2014 and explicitly call here, an empirical revolution to the study of human cognition.

Which brings me to the topic of Science-Art integration. In its simplest of definitions, I put forth that science-art integration refers to the merging of elements particular to scientific inquiry and process with elements particular to artistic expression and production to innovate a novel result. Moreover, integration moves beyond the notion of doing science and then visualizing its data and results through an artistic medium such as, for example, photography –like in taking pictures of brain slices, blowing them up, framing them behind glass, hanging them in an exhibition, asking the audience to view and imagine their own story, and declaring poetic license of expression to explain everything–, as well as creating art influenced by science themes, questions, etc. – like in building an installation that mimics the molecular structure of glial cells and invites audiences to see and feel otherwise unseen biological structures. These examples, I propose, fall under an attributive approach whereby science simply inspires art and art simply inspires science at a superficial, albeit pretty, level without any profound impact on either field of study.

Instead, I argue that science-art integration requires a much more complex and nuanced approach that leads to a significant contribution to both fields and, essentially, a new, amalgamated discipline brimming with novel discoveries and necessarily requiring further growth. Moreover, until the Science and Art worlds are reunited, the communication of such discoveries within each world is paramount and a requisite. As proposed in López-González (2015, 2016)[5,9-12] and further defined here, I take integration to mean redefining what Science traditionally is and can do as a discipline and by consequence, also redefining what Art traditionally is and can do as a discipline. This means effectively inventing a new discipline that merges the various questions, methods, data, and results from Science with the various questions, methods, contexts, and artworks from Art to create a new hybrid Science-Art discipline that is characterized by the following disciplinary transformations. As I am particularly interested in understanding and fostering creative behavior from a cognitive and an artistic standpoint, respectively, my approach is focused on creative cognition and is the very unique, theoretical foundation for which the company, La Petite Noiseuse Productions (LPNP), operates.

The Science approach at LPNP is three-fold: (S1) asking specific scientific questions about the creative process such as the relationship between language, emotion, and real-time musical improvisation with the goal of further elucidating cognitive processes; (S2) innovating the manner in which science acquires data for the study of spontaneous, multisensory, human

adaptability with the goal of obtaining new data from which to extract patterns exemplifying complex cognitive phenomena; and (S3) using ideas and concepts from perception, memory, and cognitive framing and dramatizing them into fictional stories with the goal of creating science-informed art. The Art approach at LPNP is three-fold: (A1) redefining the visual and performing arts as artistic forms with the inclusion of improvised music to a taut, concentrated dialogue; (A2) innovating a novel aesthetic with regards to the structuring of a live narrative that is reinvented every performance; and (A3) redefining art's role as a medium that simultaneously entertains, generates rich data for fundamental questions in human cognition, and communicates science in an engaging, aesthetic and powerful manner.

Perspective Shifting: Empirical Revolution No. 2

As initially stated in López-González (2016),[9] this Science-Art integration necessitates two key elements from which to build on: (i) a thorough, learned and practiced understanding of both a Science discipline *and* an Art discipline (given the societal norms that have distanced the disciplines for so long and aggrandized their contextual differences to the extent of opposition), and (ii) a liberal mindset willing to search for the essential backbone underlying both Science and Art disciplines and maneuver it to see what outcome(s) arise(s). I further remark that this type of integration as practiced by single individuals, by virtue of its intellectual and practical requirements, leads to a genuinely authentic, efficient, and robust multidisciplinary context far beyond what a "scientist and artist collaboration" can attempt to do where individuals are matched precisely because of their lack of knowledge in the other's discipline and practice for the mere sake of ticking boxes off "as interdisciplinary projects" within an institution. My claim is, therefore, that effective, productive, and cutting-edge science-art integration and collaboration results from an individual or set of individuals who are [scientist-artist]s and not from a paired set of individuals who are [scientists] with a set of individuals who are [artists]. In other words, if you, or your collaborators each know the intricacies and nuances of the disciplines in question for integration, you can "push" and "pull" elements from each without qualms and imagine an even larger number of otherwise unknown possibilities! And although outside the scope of this paper, I formally state a proposal I have advocated for as an educator since 2009: that this interdisciplinary mindset can and should be enriched from childhood or at least early adulthood and as such, why not encourage an entire new generation of polymaths!?

On the heels of LPNP's third theatrical production, to be discussed below, we have been specifically focused on answering three main questions: (a) the nuanced relationship between language and music and to what extent music can represent concepts and complex emotions, (b) the musical choices an improvising musician makes during live improvisation within a theatrical context, and (c) the audiovisual elements that characterize a live, coherent dramatic conversation. We have addressed these questions over the course of three unique dramatic plays produced on stage for live audiences by progressively changing the overall storyline presented, the content of the spoken dialogue, and the number of actors and musicians involved. With two [scientist-artist]s at the helm of LPNP, our productions have intentionally walked away from the traditional laboratory setting into the experimental space of artistic production and fully embraced the unknowns of such a space in an effort to work in the most natural of performance environments and include the audiovisual complexity unheard off within the confines of the

typical testing room. We specifically choose the music and visual and performing arts' worlds not only because of our expertise in them, but also because of their integrative multisensory and artistic experiences. Additionally, this public platform allows for live, in-the-moment creativity that is both freed and constrained by the very surrounding performance time and space. This type of work assumes that to best understand and model spontaneous artistic and communicative adaptability as it happens in real time, the behavior should be explored under the same conditions as it were to most likely occur in any other real-life circumstance. Embracing such a platform means welcoming recurring patterns, variability in all its forms and sizes, and irreproducibility with open arms and in effect blurring the lines traditionally upheld by Science and Art disciplines.

Última Partida / The Final Draw

As discussed in López-González (2015)[5] and most recently presented in López-González (2016),[10-12] I wrote and directed in 2014 the one-act Spanish-language play *Última Partida* (*The Final Draw*)[13] with English surtitles. The drama has three characters: a woman and a man, whose intimate relationship unravels one night in a cabaret while the cabaret's pianist, the third character, improvises live every performance in reaction to the emotions and body language of the character's storyline. The setup was therefore a fully scripted linguistic dialogue and an improvising musician. I crafted the play such that the so-called six universal human emotions –anger, disgust, fear, happiness, sadness, and surprise– were the narrative foundation from which the story's events unraveled. Summarizing briefly, analysis of the improvised music from a randomly selected live performance by emotion and the musical variables implemented (mode, pitch, rhythm, sound level, tempo), revealed that the musician both mimicked the behavioral nuances of the target emotion (e.g. clashing emotions between the couple via dissonant semitone clusters) and represented the surrounding narrative environment (e.g. shattering glass statue) via various combinations of those musical variables in order to spontaneously emphasize or highlight a specific moment deemed narratively significant to the story.

In Session / Chez L'Analyste

As discussed in López-González (2016)[9] and most recently presented in López-González (2016),[10-12] in 2015 I directed, and starred in a lead role in the one-act drama *In Session*, which I wrote as two separate works both in English and in French (*Chez L'Analyste*).[14] As with *Última Partida*, there are three characters: a female therapist who doubles as a patient, a female client who doubles as a plastic surgeon doctor, and an improvising radio pianist who reacts in real-time to the actresses on stage throughout a single psychotherapeutic session. While full of emotional content, I was particularly interested in pushing the boundaries of music as both an expressionist emotional voice and as a communicative system of more abstract content. More thematically cerebral than *Última Partida*, *In Session* addresses current big questions in human and artificial intelligence through an interplay of audiovisual perceptual experiences as described by the characters, the revelation of each characters' personal stories, and the very questioning of consciousness through self and societal awareness. The setup was therefore a fully scripted linguistic dialogue and an improvising musician. Summarizing briefly, analysis of the improvised music from a randomly selected live performance revealed that in the absence of clearly marked emotional targets, the improvising musician spontaneously identified a global narrative emotion within particular dialogue sequences and created "matching" musical phrases that reflected

the expected behavioral reaction(s) to such emotion (e.g. emotional agitation expressed via disjointed rhythmic sequences and a mix of half and whole steps). Moreover, every emotion identified – whether new, similar, or previously encountered– was musically "translated" via different combinations of musical variables.

Continuing in this vein of live, scripted drama and musical improvisation to characterize in as many elements as possible how spontaneous artistic adaptability unravels and consequently affects the resulting dramatic experience (with the future intention to flip the scenario to live, scored music and linguistic improvisation for comparison), I discuss below a new project I wrote, directed, and acted in a lead role titled *Framed Illusion*.[15] As with the other two plays, I wrote two separate works, one in English and one in Italian under the title *Cornice Di Un'Illusione*. The project discussed here was funded and produced in English by La Petite Noiseuse Productions in 2016.

Methodology

Framed Illusion is the third installment of two-character, one-act plays specifically created to be performed with live musical improvisation. An aficionada of the *noir* genre in film for all its stark chiaroscuros, slick double-crossings, sultry characters, and jazz scoring, I wrote *Framed Illusion* with the intent to deconstruct various aspects of that particular narrative world on stage and to make explicit the instability of our perceptions and their consequences on memory and storytelling. Using crime, interrogation, the religious confession, and the act of writing as a backdrop to address the "problem of perception," the unreliability and suggestibility of perception and memory unfold with the introduction of four fictitious characters in this psychological thriller: a female detective and a female suspect and two jazz musicians. An improvised musical prologue precedes the main scene of action, which unfolds within an interrogation room decorated with a single white light bulb above a black table and two chairs, a camera on a tripod lit with a green light, and four mirrors flanking the room to suggest two-way mirrors. The two women are elegantly dressed, both having come from their respective parties, and still in their cocktail attire of black, silver, and nude-colored lace. Throughout their conversation we learn that a man has been murdered, the suspect is the man's ghostwriter, the detective is a photographer, the characters are inevitably linked, and the divide between fact and fiction is unclear… all while the two musicians on stage but "outside" of the interrogation room improvise away as they react to the action every performance.

Framed Illusion: The Play's Specs

"Ha, don't you love how inconsistent our perceptions are?" (ii, p. 45)

asks the Detective character to the general audience in a moment, of several throughout the play, where she breaks the fourth wall to underscore the characters' contradictory perceptions regarding "facts."[15] *Framed Illusion* is an original one-act dramatic play I also directed and acted in to specifically bring together four fictitious characters on stage: a detective, a suspect, a bassist and a trumpeter. Purposefully moving away from the sexist and violent versions of police interrogation scenes typical within film, TV, and theatre, I chose the context of interrogation as a natural conversational paradigm to pair two intelligent *femmes fatales* in a game of wits. Throughout the interrogation they move from formulaic cross-examination, empathic exchanges, and subtle

insinuations, to emotional domination, perceptual manipulation, and revelatory truths without using foul language or physical force.
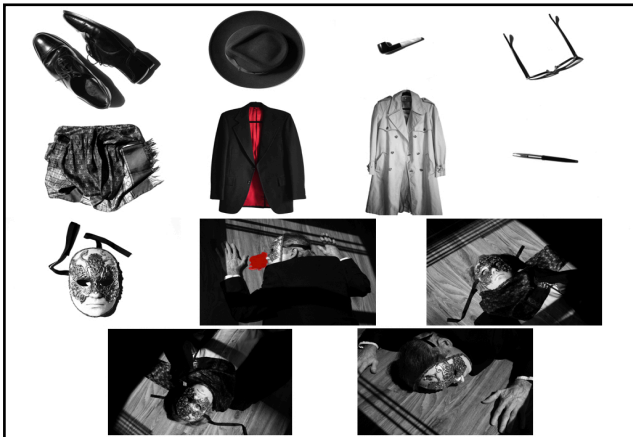
Figure 1. Collage of black and white digital crime scene photographs used as incriminating evidence during the live theatrical production of Framed Illusion *performed in Baltimore, MD June 2016.*

Figure 2. Photo still from a live theatrical production of Framed Illusion *performed in Baltimore, MD June 2016. The characters (inadvertently) switch roles in a moment of brutal honesty where the 'Detective' reveals her murderous intentions and the 'Suspect' serves as her confessor...*

This context further allowed me to exchange typical *noir* narrative elements of seedy nightclubs, guns, slick streets, and accompanying jazz soundtracks for book-signing cocktails, steaming digital black and white photographs (Figure 1), priestesses in confessionals (Figure 2), and two live musicians to simultaneously trade musical ideas in reaction to the scene's actions (instead of one musician as in our previous two theatrical productions). See Figure 3 for a scene of the staged conversational setup in the interrogation room.

A key element of this theatrical work is the presence of a bassist and trumpeter assigned to improvise music live on stage every time the play is performed. I specifically created their roles not only for experimental purposes, but as a way to challenge the *noir* genre "sound" both on-screen and onstage by pairing bass strings with a horn and tasking them with spontaneously reacting to the emotional and conceptual narrative of the dialogue, the actors' body language, and the overall scene either during the characters' conversation or during moments of silence explicitly stated in the text.

Figure 3. Photo still from live theatrical production of Framed Illusion *performed in Baltimore, MD June 2016. The 'Detective' cunningly incriminates the 'Suspect.'*

For the attending audience, *Framed Illusion* is an artistic, entertaining experience and narrative elements were woven into the following sections and scenes:

Prologue performed by the bassist and the trumpeter located upstage right and left, respectively, and flooded by a silvery blue light. This prologue is the musical equivalent to a cinematic narrative leading up to the interrogation room action to unfold. The musicians musically chronicle a confrontation leading to murder, a party interrupted by the police, and the few moments at the police station right before entering interrogation.

i. *Introductions* where we meet a young female Suspect (for murder charges) and a young female Detective in an interrogation room as a full white light bathes the room. We learn that the Suspect has been brought from a book-signing cocktail party and about how she came to be the ghostwriter for an institutional president's latest book. We soon discover that the Suspect had interviewed the president (who has been murdered) incognito in various confessionals, a fact the Detective uses to suggest more than a professional relationship between them.

ii. *Revelations* finds the Detective searching for information about the Suspect's beginnings as a ghostwriter and writing style, particularly regarding the murdered man's book. The Suspect begins to suspect the Detective knows much more about the murdered man's macho personality than she does. Moments become temporally tense as the Suspect begins to defend her innocence and reveal her suspicions about the Detective's relationship with the president before the Detective demarcates her authority.

iii. *35 Millimeters* moves into the evidence part of the interrogation. The Suspect very cleverly equates writing to photography as she implies the Detective may have taken the crime scene photographs, herself an accomplished photographer, instead of her forensics team upon arriving at the scene of the crime.

iv. *Distorted Memories* has the Detective cunningly and aggressively implanting false memories in the Suspect as they walk through a set of selective crime scene photographs. The lights in this scene are particularly stark, enclosing the Suspect and Detective in harsh shadows. The Detective admits to murdering the man.

Interlude performed by the bassist and the trumpeter as the Detective and Suspect stand and sit, respectively, motionless facing the audience. This interlude is the musical equivalent to a cinematic narrative leading up to the ensuing confession in *Mea Culpa*. The musicians create a church-like atmosphere.

v. *Mea Culpa* is the Detective's fiery confession behind her murderous intentions with the Suspect as her implied confessor. With blood-red lighting and the Suspect and Detective downstage right and left, respectively, the Detective expounds on her feminist motivations.

vi. *Reversed Frames* comes right as the full white lights of the interrogation room return and the Suspect, knowing that the Detective committed the murder, accuses the Detective of indicting her for murder and of using her power to alter "reality" in her favor. Throwing sarcastic epithets at one another all in the name of biased perceptions, the stage lights turn black just as a combative climax is reached.

Musical Improvisation In Theatre: Take 3 with a Duo

As mentioned, a key part of this theatrical production is the inclusion of improvising musicians. While the dialogue between the detective and suspect characters is fixed, the musical one is not. Furthermore, the scripted dialogue is intricate and full of emotions, thoughts, concepts and situations. This setup offers musicians a highly complex, ever-changing environment to identify, imagine, share, develop, and transform musical ideas from visual and literary cues in real time without losing a beat. The musical result, therefore, is an immediate and aleatoric solution consisting of different and unique music every performance. In contrast to my previous film and theatre projects where I created emotional visual and linguistic stimuli specific to the six basic universal human emotions (i.e. anger, disgust, fear, happiness, sadness, surprise),[5] tested out specific abstract ideas and concepts,[9] and worked with single instrumentalists,[5,9] this project (a) involved two musicians, (b) offered them a single general dark atmosphere filled with nuanced moments of tenseness, tantalization, uneasiness, sarcasm, and suspense, and (c) provided them with two significant moments (the *Prologue* and *Interlude*) to create musical "scenes" without any visual or linguistic input and only knowledge of the ensuing (and previous) narrative context. As such, the questions are: How will musicians spontaneously "narrate" an untold story? What kind of "conversation" will they engage in and what does it entail? Will they pick characters to represent? What will they highlight from the narrative? The characters emotions, body language, words?

The bassist and trumpeter who improvised the music for every performance had an average of fifteen years combined professional experience as performers and composers and although the bassist had done one musical theatre project containing scored work before, neither musician had improvised live for a theatrical production of this type. Additionally, the musicians had never played together before this project. I met with the musicians several weeks prior to rehearsals with the other actor to discuss their role and the overall storyline. The musicians then attended the last week of rehearsals to familiarize themselves with the dialogue, stage and musical entrance and exit cues explicitly noted in the text, and timing between scenes. A soundtrack, however, was not charted out or scored to allow for unbiased and entirely free improvisations during performances. The play was presented to the public ten times in the metropolitan Baltimore, Maryland area June 2016 and a Q&A followed every performance. All performances were photographed and audio and video recorded live (selections can be found at www.lpnproductions.com/Theatre.html). The musical data presented here come from a randomly selected performance –as a side note, an informal review of all the recordings from every performance revealed that aside from specific entrance and exit cues and overall general emotional content created by the music, all the musical improvisations were different and unique to each performance. After randomly selecting a performance, I interviewed the musicians about the technical musical aspects of the recorded, improvised composition. The total amount of music improvised during this performance was 71 minutes and 49 seconds long out of a total performance time of 100 minutes and 23 seconds. To reiterate, my specific experimental questions were: (1) What effects do linguistic and visual stimuli have on improvised musical content? (2) How will the presence of two musicians affect the improvised composition? (3) What do the data reveal about adaptive behavior in the spontaneous, artistic decision-making process? Particularly, what does live musical composition tell us about the dramatic narrative(s) audiences will experience?

Data and Results

Picture the setup: you are sitting in the audience watching and listening to a play complete with dialogue and live music (for which you are aware is being improvised on the spot). Everything is seamless and just "fits." How *does* everything work together? To answer this question, I continue to uniquely merge music feature analysis with a *mise-en-scène* analysis to determine how musicians use music, with its various features (key, mode, pitch, rhythm, tempo), to represent elaborate, incoming visuo-linguistic input (see López-González 2015 and 2016 for definitional details).[5,9] This paradigm allows for identifying what musicians spontaneously focus on and why.

A detailed time analysis of a random, single performance recording from *Framed Illusion* revealed the following significant musical changes visually elaborated and drawn to scale in Figures 4 through 11 and discussed in Tables 1 through 8, respectively. Significant musical changes are defined as moments in which the music altered significantly in one or more ways with regards to key, rhythm, and/or narrative intent.
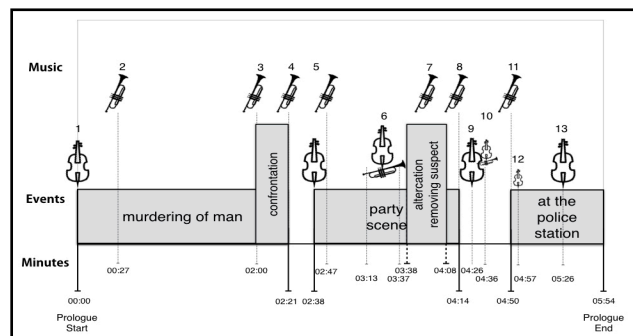

Figure 4. *Significant musical observations by narrative events across time (in minutes) from Prologue.*

Table 1. Key for Figure 4 about *Prologue*.

1. Bass slithering around: full range of instrument, no regular pulse, started with harmonics and partial sounds (harder to control and kind of 'unnatural' on bass) to transition to something semi-octatonic although fairly chromatic against a pedal on the D string, then eventually worked in a G, F# harmonic. No key.

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|---|
| 2. Trumpet sparse: clear pitches, no sound effects, no regular pulse, no long phrases, no clear melody, no key center. |
| 3. Trumpet creating sound effect: represent "the act of killing" with half-valve (not depressing valve completely) downward glissando into very sharply accented note. |
| 4. Trumpet creating sound effect: ambulance cue (murdered body being removed by forensics team). |
| 5. Bass enters first, then trumpet to create jazzy ambient party music: D minor key, bossa nova rhythmic feel. |
| 6. Foreshadowing tension (within party with police busting in to take Suspect away) via rhythm: trumpet decides on a swing feel on top of bass' spontaneously decided bossa feel. |
| 7. Interjecting with phrases to represent altercation during party while jazzy ambient music continues (F Major key - relative Major to D minor, same ionian mode for both keys). |
| 8. Trumpet creating sound effect: police siren cue (Suspect being taken away from party by police). |
| 9. Bass creates sound effect: Detective's phone ringing. |
| 10. Trumpet picks up bass' phone ring idea and represents conversation at police station while bass represents conversation over phone by smacking body of instrument. |
| 11. Trumpet creating sound effect: cutting notes short and hyperventilating through trumpet to represent Suspect's short breaths of fear, nervousness, and vulnerability. |
| 12. Bass in E flat octatonic (scale with four centers to it - depends which note is spontaneously emphasized throughout the scale). |
| 13. Bass introduces a theme to associate with Detective (i.e. "Detective leitmotif"). |
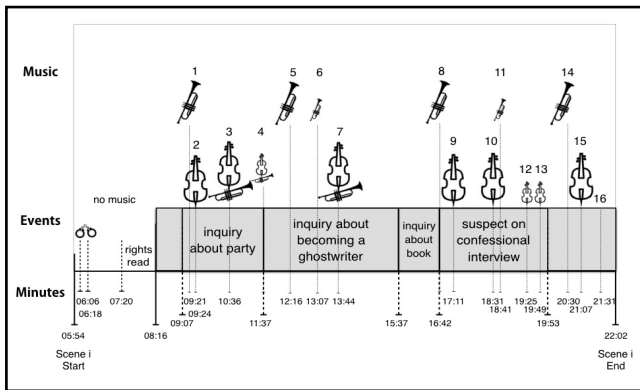
Figure 5. *Significant musical observations by narrative events across time (in minutes) from Scene i. Introductions.*

Table 2. Key for Figure 5 about *Scene i. Introductions*.

1. Trumpet starts in A minor key and modulates around.
2. Bass spontaneously starts playing "Stella by Starlight" song. Moves into B flat Major key for the ambient party song.
3. Both switch to B flat Major's parallel minor: B flat minor key.
4. Slow decrescendo to stop party music.
5. Trumpet solo begins & creates cyclical sound effect with quarter notes: no key, no regular pulse, start with 4ths then a 3rd and a 6th.

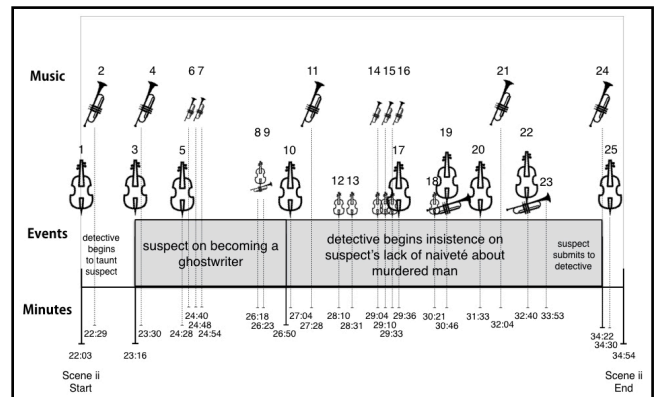| |
|---|
| 6. Trumpet stops. |
| 7. Trumpet and bass enter together. Bass reorganizes the murder scene introduced in the prologue and remains still with a G and F# harmonic to become a threaded F# ("*life-threatening circumstances*"), adds tritone to increase tension, then back to harmonic. Momentum picks up as questions from Detective to Suspect become more insinuating. Bass starts creating a sticky, scraping sound effect for when the Detective is getting mad or must think on her feet. Trumpet creates sound effects throughout to mimic Suspect's wording: multiple notes in succession, pairs of two notes around a pitch, quick fanfare, bluesy touches, etc. |
| 8. Trumpet begins church-like music in A flat Major key as discussion turns to Suspect describing her interviews with the murdered man being held in confessionals. |
| 9. Transition to B flat minor key, jazzier chord sequence (V, IV: F minor, E flat minor). |
| 10. Bass creating slapping sounds to represent micro-aggressions; back to quadruple time to represent "pursuit theme" (i.e. Detective after Suspect). |
| 11. Trumpet matches words being said: ex. fifteen repeated notes for mentioning of "*fifteen minutes*." Bass hangs around same couple of pitches as conversation slightly stalls. |
| 12. Bass back to V, IV (F minor, E flat minor keys) for "*…disobey the priestess…*" |
| 13. Bass back to E flat octatonic (with chords) to musically clear the air after so many notes in a row immediately before. |
| 14. Trumpet creates sound effect and mimics Suspect's laughing with quick biting, sharp glissandos. |
| 15. Bass becomes louder to represent the growing contempt in the room while trumpet returns to cycling quarter notes. |
| 16. Music stops. |

Figure 6. *Significant musical observations by narrative events across time (in minutes) from Scene ii. Revelations.*

Table 3. Key for Figure 6 about *Scene ii. Revelations*.

1. Bass creates creaking noise underneath with fingertips rubbing against body of instrument.
2. Trumpet creating sound effect to mimic language with a chromatic.
3. Waltz in D flat Major (commonly associated as being a "happy"

key) - relative Major of murdered man theme.
4. Trumpet enters with sing-song-type simple melodies.
5. Back to murdered man theme: B flat minor key.
6. Trumpet creating sound effect with stacks of upward thirds to represent "*stories being collated*."
7. Trumpet creating sound effect with repeated trills to represent a phone ringing from Suspect receiving a call from an editor.
8. Trumpet creating sound effect with repeated legato note to represent "*longing*."
9. Bass represents Detective becoming "pissed off" with creaking noise underneath.
10. Bass introduces later "mask reveal" theme instigated by Detective with a low A flat and a high G.
11. Trumpet reenters.
12. Bass adding harmonics on top of A, playing with velocity, adding other harmonics on top.
13. Bass returns to low note.
14. Trumpet creating sound effect with a raunchy bluesy-type phrase to represent "*young, attractive*" description of Suspect by Detective. Bass alternating between different types of symmetrical scales on A, a lot of whole-tone and diminished.
15. Trumpet creating sound effect with first few degrees of a Major scale to represent a square-sounding "…*almost too smart for your own good*…" comment by Detective to Suspect. Bass alternating between different types of symmetrical scales on A, a lot of whole-tone and diminished.
16. Trumpet creating word sound effects with 6 syllables, 6 notes-phrase to represent "*chauvinistic banter*"; with repeated notes to represent a "*stroking ego*" sound; with surrounding chromatics: down a whole step, up a half step - to represent being "*cornered*."
17. Bass enters with high impact note, continues with symmetric scales, creates higher motion (how quickly notes are moving by) to represent some kind of upward race to higher intensity between Suspect and Detective.
18. Bass plays low pedal D flat and alternating it between open strings (since aware of moving towards a section of stasis ahead).
19. Bass and trumpet reenter. Trumpet does alternative fingerings on F (his G) and produces interjections every time Suspect emphasizes a word, with each interjection going up chromatically.
20. Bass enters solo with Detective theme from prologue in E flat octatonic.
21. Trumpet enters with single notes; then upward glissandos; repeated notes; downward chromatic.
22. Bass turns E flat octatonic Detective theme into chaos - no key signature; both bass and trumpet crescendo.
23. Music stops.
24. Trumpet creating sound effects: short breaths via exhaling through trumpet.
25. Bass representing Detective's mental state during attempted strangle ("inner monologue of hideous machinery clicking into place"): creaking noise and spur-of-the-moment rhythmic hitting

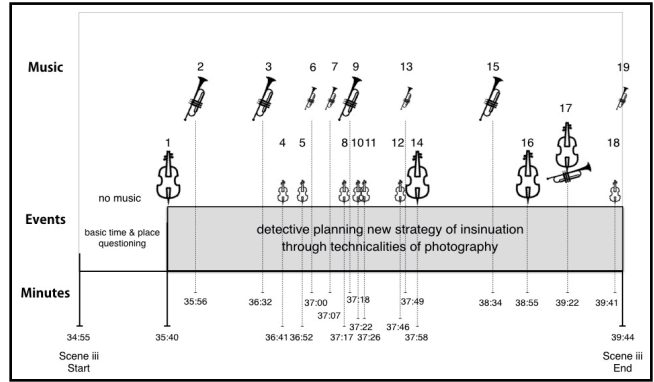| |
|---|
| (palm forced into back of bass). |

Figure 7. *Significant musical observations by narrative events across time (in minutes) from Scene iii. 35 Millimeters.*

Table 4. Key for Figure 7 about *Scene iii. 35 Millimeters*.

| |
|---|
| 1. Bass creates creaking noise effect. |
| 2. Trumpet enters with sparse notes - spontaneously playing around with horn against music stand to mute it and release it slightly away. |
| 3. Trumpet creating sound effect to represent a camera's shutter being depressed. |
| 4. Bass creates creaking noise effect via scraping slightly as Detective scrambles for an answer (as Suspect catches on to Detective's plan). |
| 5. Bass continues to create creaking noise effect via scraping slightly more. |
| 6. Trumpet repeats sound effect representing a camera's shutter being depressed. |
| 7. Trumpet repeats sound effect representing a camera's shutter being depressed. |
| 8. Bass continues to create creaking noise effect. |
| 9. Trumpet plays upward and downward intervals. |
| 10. Bass continues with creaking noise effect. |
| 11. Bass continues with creaking noise effect. |
| 12. Bass stops creaking noise effect. |
| 13. Trumpet stops. |
| 14. Bass enters with the "reveal" theme - F sharp and G, starting out on harmonics; although generally indeterminate. |
| 15. Trumpet creating sound effect to represent "…*so that's how you stitch your narrative together*…" with the sound of a sewing machine, then starts adding pitches instead of just air. |
| 16. Bass goes lower. |
| 17. Roles briefly switch and become more melodic: bass higher, trumpet lower, then bass lower, trumpet higher. |
| 18. Bass stops. |
| 19. Trumpet stops. |
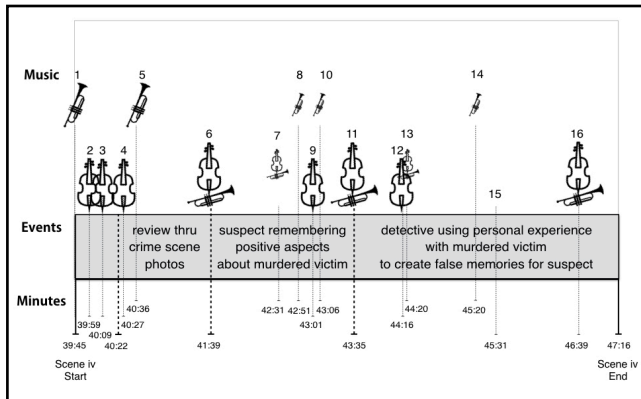
Figure 8. *Significant musical observations by narrative events across time (in minutes) from Scene iv. Distorted Memories.*

Table 5. Key for Figure 8 about *Scene iv. Distorted Memories*.

1. Trumpet enters with single pitches in upward and downward intervals.
2. Bass enters with soft creaking sound.
3. Bass intensifies sound in imitating Detective's language by creating a grinding sound partially to create two voices to represent the Detective becoming 'possessed' with a smoky lower tone to emphasize her 'evil' tone and partially to pair with the muting of all the strings and over-pressuring of the bow and drawing very hard so there no pitches, only the sound of catching and releasing strings over and over again.
4. As the Detective walks the Suspect through a set of photographs, the bass starts and uses bow pressure to create subharmonics (where a harmonic gets pitched down); F# on bottom with F, G, or A notes on top (depending on how much he stretched his hand, thus the indeterminacy of exact pitches).
5. Trumpet enters with random, small melodic phrases and continues with Major keys with no direction other than to avoid any brooding minor sounds.
6. Trumpet and bass more melodic. Trumpet in G Major key (to represent a happy, fond memory), bass releases G string back to G and F# (one fundamental and one harmonic on top ringing) for a continuous sound.
7. Trumpet creating sound effect to represent *"…every curve of his body"* description by Detective about murdered man via 4-note chromatic rolls. Bass continues with ringing sound.
8. Trumpet creating sound effect to represent a shared raunchy experience between Detective and murdered man and Suspect and murdered man by playing a slurred, bluesy phrase.
9. Bass with two Gs played in unison until softly clearing out.
10. Trumpet enters with single pitches in accented upward intervals.
11. Intense and loud frustrated exclamations from trumpet with flipped bow upside down and smacked strings of bass - no exact pitches, more percussive effect to create a 'dehumanizing' effect.
12. Bassist spontaneously deciding to bow on the music stand starting with two long tones to introduce a new texture.

| 13. Trumpet enters creating sound effect to represent "*…to help you pull the trigger to bring them back [the memories]*" with a quick double tone and then release with a warm tone; to represent "*reveling in the pleasure of watching him succumb to your will*" with rhythmically mirroring the dialogue, briefly centering around F. Bassist continues with bowing on stand with short punches to fall in with the dialogue as Detective proceeds through reasons for murder, and then eventually bowing is long enough to produce upper harmonic screeching sounds for Detective's last line of insinuation. |
| --- |
| 14. Trumpet enters with short intervals to represent Suspect's hesitation in accepting the murdered man's domination over her. |
| 15. Silence as Detective recounts personal experience. |
| 16. Bass and trumpet enter together. Bass picks "predictable to catch" harmonics on a G and F# and then over-pressures them to create a subharmonic grind (bow happened to randomly get caught on string). Trumpet mimics the Detective's descriptive language of "*…you'd tie him up by his wrists and ankles*" with an octave and a half-valve glissando downward into a hard accent. |
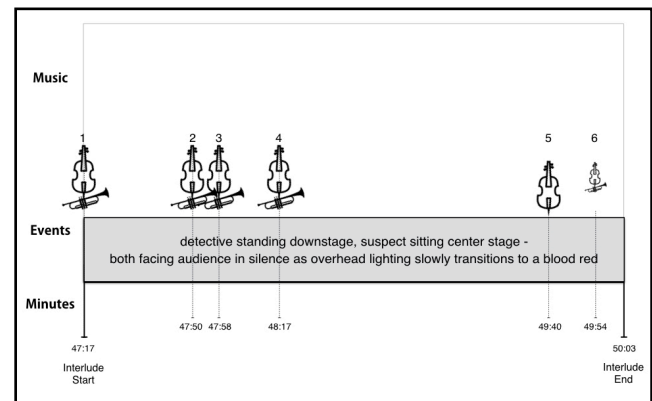
Figure 9. *Significant musical observations by narrative events across time (in minutes) from Interlude.*

Table 6. Key for Figure 9 about *Interlude*.

| 1. Both bass and trumpet playing around with a lot of diminished sounds. |
| --- |
| 2. Both bass and trumpet return to murder scene introduced in prologue but more subdued. |
| 3. Downward spontaneous synchronized tremolo back and forth between bass then trumpet (handshakes), slowly decrescendo from forte to pianissimo. |
| 4. Trumpet begins church theme (back and forth between G and D Major keys). Bassist intently listening to trumpeter to predict what notes to play as a bass line to the trumpet in a spur-of-the-moment decision: chromatically going downward (like in a baroque experiment with contrapuntal movement). |
| 5. Bass makes a chord progression out of the bass line. |
| 6. Bass plays lower note cue for Suspect to walk towards confession scene. Trumpet continues with church theme as bass continues with lower bass line. |
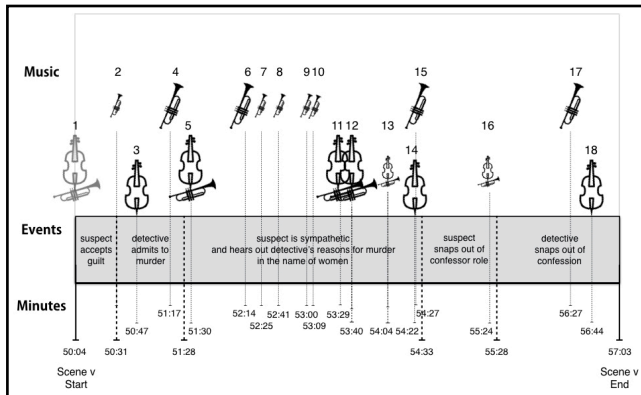
Figure 10. *Significant musical observations by narrative events across time (in minutes) from Scene v. Mea Culpa.*

Table 7. Key for Figure 10 about *Scene v. Mea Culpa*.

1. Bass and trumpet continue church theme from prelude.
2. Trumpet stops.
3. Solo bass in G Major key souring a bit.
4. Trumpet enters with single pitches up and down.
5. Transition into something kind of B flat-ish, trumpet playing B sharp, then bass picking dyads (two-note chords) to follow one another to undercut everything the trumpet is playing.
6. Trumpet creating sound effect to represent the phrase "…*for womankind*…" with a brief fanfare in B flat Major key; accented notes to represent "…*dominated, abused, violated, and killed*…"
7. Trumpet changes to B flat minor key for the phrase "…*for the sheer pleasure of watching the man squirm under*…"
8. Trumpet creating sound effect to represent the phrase "…upend a literary idiosyncrasy…" with an extended bend upward.
9. Trumpet creating sound effect to represent the phrase "…*years and years of repeated actions*…" with repeated notes.
10. Trumpet creating sound effect to represent the phrase "…*this one blip within the rows and rows of accumulated stories*…" with 'blips between rows' as in very quick higher notes outside the row of notes.
11. Trumpet changes from Major key with the phrase *"…how do you think little girls will respond…"* to minor key with the phrase *"…how will little boys respond?"* Bass transposes the interval set played during the line *"I want to know what's behind the armor of words you so convincingly use"* from scene ii from a low D flat plus an A to now an A and an F (up a minor sixth).
12. Spontaneous implicit synchronization between bass and trumpet: Trumpet creating sound effect to represent the phrase "…*the power dynamic is equalized*" with first starting an octave apart, then dominant 7th apart, going up and down by smaller intervals each time to land at the middle tritone pitch. Meanwhile, bass started out on an open fifth on the A string and as the lower swing went up in whole steps, the higher string went up in half steps (thus approaching each other).
13. Synchronization between bass and trumpet ends.

| |
|---|
| 14. Bass creating sound effect to represent "…*where am I hearing these voices*" initially by spontaneously matching the Suspect's rhythm to creep in, then balancing the bow on the body, bowing the stand, bowing muted strings, bowing the tailpiece. |
| 15. Trumpet enters to create sound effect to represent "*voices*" with growling, half-valving, and moving trumpet bell off (to get a released sound) and on (to get a muted sound) the music stand. |
| 16. Bass and trumpet abruptly stop creating voices after a slow crescendo. |
| 17. Trumpet enters by repeating a sequence (around the phrase "*you were transfixed*" said by Suspect to Detective) from scene i. |
| 18. Bass enters and eventually begins strumming chords to head back into Detective theme. |
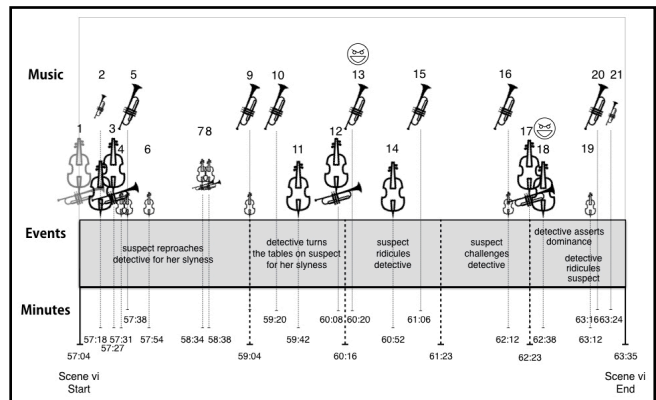
Figure 11. *Significant musical observations by narrative events across time (in minutes) from Scene vi. Reversed Frames.*

Table 8. Key for Figure 11 about *Scene vi. Reversed Frames*.

1. Moving into detective theme from prologue.
2. Bass replaying detective theme from prologue with a forte sound and following rhythm from the dialogue. Trumpet adds an upward glissando at the word "*warped*."
3. Detective theme variation in E flat octatonic-ish with musical elements reorganized but the same notational curve to it.
4. Further Detective theme variation.
5. Trumpet (and bass spontaneously in synchrony) mimicking Suspect's sequential description of Detective by moving the key upward in half steps (E flat minor, E minor, F minor) with each adjective: "…*selfish, intimidating, ravishingly confident*…"
6. Further Detective theme variation.
7. Both highlight the phrase "…*the ultimate citizen above suspicion*" with the bass playing a reversed fanfare by arpeggiating a minor triad downwards from the root to the root (i.e. an intervalic inversion of the upward fanfare) and trumpet with upward glissando.
8. Further detective theme variation.

9. Trumpet (and bass) mimicking Detective's sequential description of Suspect by moving the key upward in half steps (F minor, F# minor, G minor) with each verb: "…*interviewed him, understood him, and even penned his story*…"

10. Trumpet moving valves quickly with no discernible pitches.

11. Bass breaks the Detective theme by creating a new rattling/buzzing sound: pushes the strings off the side of the fingerboard as Detective cunningly compares Suspect's "authoring" of the murdered man's book to their collective "authoring" of the current interrogation.

12. Clear F# G, F# G pitches as Detective makes clear to Suspect the suggestibility of "perception and memories."

13. Solo trumpet mimics Suspect's scornful laugh in sound, pitch range, and rhythm - biting (short, forceful exhalations) inside the trumpet with quick downward glissandos and no discrete pitches.

14. Bass plays with velocity on a pedal, re-articulating as things become tenser, greater velocity, as they become less tense, lower velocity.

15. Trumpet enters.

16. Momentum decreases. Trumpet ends with creating sound effect to represent the released shutter button of a camera as the Detective says "*the camera hardly has those biases*."

17. Both bass and trumpet play pairs of notes to mimic the "*eyes*" peering through the glass watching the interrogation and then speed up and crescendo to an abrupt stop as Detective asserts her dominance with the bass transitioning to a grinding sound to imitate Detective's voice.

18. Solo bass mimics Detective's sadistic laugh in both sound, pitch range, and rhythm by muting all the strings, over-pressuring the bow, and tremolo bowing.

19. Bass stops.

20. Trumpet mimics suspect's short breaths by hyperventilating through horn, returning to beginning of scene i.

21. Trumpet stops.

Discussion
Narrative Unity Lies in the Musical Variability

The current results confirm our previous observations and suggest further nuanced characteristics of real-time spontaneous adaptability when there are four interlocutors: (1) music adds to the linguistic dialogue by creating an overarching emotional percept and, as common in film and theatre, frames the atmosphere, (2) musicians explicitly choose and elaborate on specific musical features (e.g. mode, key vs. no key), instrument attributes (e.g. muting strings on bass, half-valving on trumpet), and resulting musical sequences to represent and mimic emotional and physical characteristics identified within the scene's narrative –more specifically, mental states, word phrasings, and onomatopoeic sound effects, (3) musical features and instrument attributes chosen in-the-moment to mimic the emotional and physical characteristic(s) identified are combined, recombined, and transformed to continually create novel musical sequences, and (4) individual musical ideas are selected (both purposely –e.g. rhythmic tension in *Prologue*– and inadvertently –e.g.

synchronized tremolo in *Interlude*) and shared with the other musician for further idea development through exchange.

I break down in Figures 12 through 15 the dynamic process of idea creation, shared mental spaces, idea merging, and the resulting musical execution that led to a unified, breathtaking music-linguistic quartet on stage. Figure 12 visualizes the visual and audial setup of *Framed Illusion* and the resulting narratives.
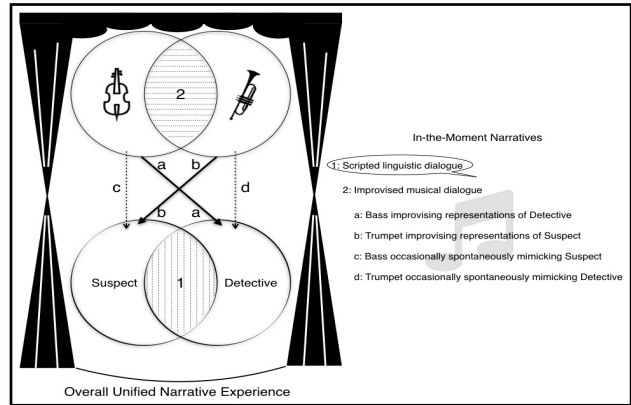

Figure 12. Schematic drawing of the elements that lead to a live, coherent audiovisual dramatic work in the context of live, improvised music. In the case of a theatrical production, several concurrent narratives create a unified, narrative experience for the audience: (1) The scripted linguistic dialogue acted out by the actors and (2) the improvised musical dialogue created by the musicians. Given the presence of two actors and two musicians, however, a further set of narratives arise: (a) the bassist character primarily taking the role of representing the emotions of and conceptual space surrounding the detective character; (b) the trumpeter primarily taking the role of representing the emotions of and conceptual space surrounding the suspect character; (c) and (d) spontaneously mimicking the other character's word phrasings: the bassist for the Suspect and the trumpeter for the Detective. This crisscrossed interchange created a one of a kind multilayered musical experience.

Figure 13 visualizes the mental "toolbox" each musician has as they listen and observe an intricate scripted dialogue unfold.
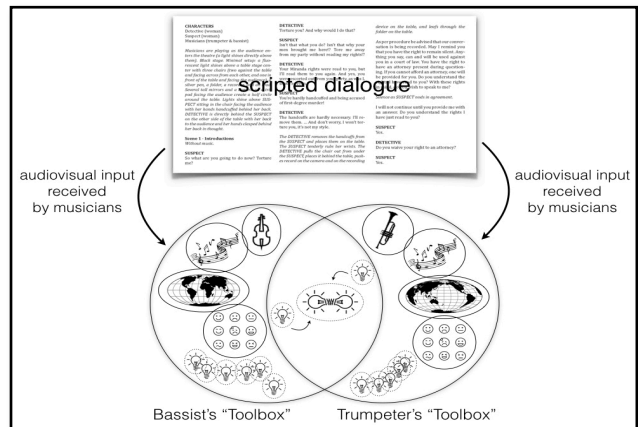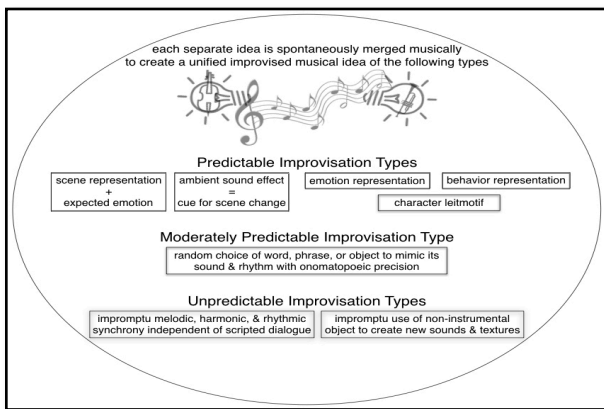

Figure 13. Schematic drawing of each musician's mental "toolbox" that consists of knowledge of (i) their instrument (physical possibilities and constraints), (ii) music theory, (iii) Western music and cultural specifics learned from experience, and (iv) emotion perception and recognition, and the emergence of (v) new ideas influenced by the incoming audiovisual input and the above knowledge set. In the center of the union of the two musicians' mental toolboxes is the merging of ideas. As the data reveal, when one of the musicians entered with a musical idea, the other musician immediately expanded upon or undermined it with yet another idea.

Figures 14 and 15 zoom into what shared improvised musical ideas resulted in to create seamless audiovisual moments.
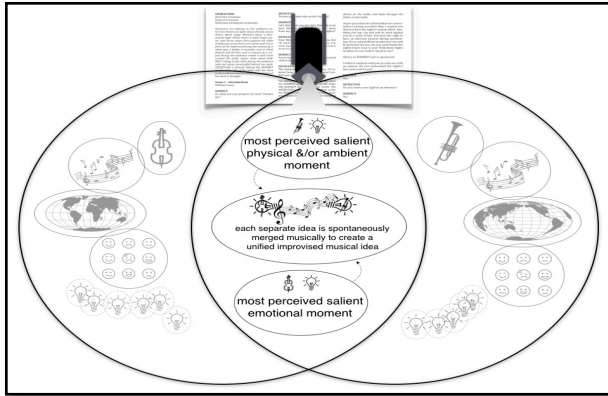
Figure 14. *Schematic drawing focusing on the union between the musicians' shared mental space. The bassist primarily picked what he identified were the most salient emotional moments while the trumpeter those more physical, and/or ambient related.*

Figure 15. *Schematic drawing of what a spontaneously, shared musical idea between two musicians within theatre represents. Although all the music performed was improvised in the moment, some improvisations were more predictable than others: (a) very predictable types relating to atmosphere building through a scene's overall emotion, meaningful sound effects to cue in a scene change, and single emotion, behavior, and character theme representations; (b) moderately predictable type primarily created by the trumpeter character involving onomatopoeic mimicry of randomly selected words, phrases, or object descriptions; and (c) unpredictable improvisation types regarding the emergence of synchronized musical ideas between the musicians uninfluenced by contextual script input and the impulsive use of a nearby non-instrumental object to invent a novel texture.*

Conclusions

Now more than ever disciplines have reached unavoidable crossroads. They can continue siloed, churning out the familiar, habitual, and comforting results and experiences with ever-slight transformations for years to come, or they can venture into the unknown and discover the rich variability that permeates our cognitive experiences. We at La Petite Noiseuse Productions have pushed forward the latter kind of thinking so that others may join our experimental revolution to understanding human cognition beyond regular pattern recognition.

I leave you with this final scenario. Imagine you, the Science-Art interdisciplinarian, in the following conversation with your former doctoral thesis advisor: You: *What if I had made a movie instead of written a dissertation? Why does that not count as a valid piece of work showing my experimental and theoretical skills?* Them: *Because a dissertation is the requirement and you can't evaluate those skills you're talking about from a movie.* You: *Says who? The years of established norms of education?* Them:

Yes, years of a tried-and-tested system of training, delivery and evaluation. You: *What if that system were to change? And you were to have the interdisciplinary skills to evaluate my movie?* Them: *Then yes, I suppose a movie would be valid.* You: *So will you take the challenge to continue this dialogue?*

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