THE PHILOSOPHY OF ACTION IN LIVE PERFORMANCE INTERACTION DESIGN: ALIGNING FLOWS OF INTENTIONALITY

by

David J. Wright

B.A. English and Theatre, Belhaven University, 2002

M.A. Philosophy of Religion and Ethics, BIOLA University, 2005

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This dissertation was presented

by

David J. Wright

It was defended on

May 11, 2015

and approved by

Brett Ashley Crawford, Assistant Teaching Professor, Arts Management, Carnegie Mellon University Heinz School of Public Policy and Management

Ryan McDermott, Assistant Professor, English & Theatre Arts

Jennifer Waldron, Associate Professor, English & Theatre Arts

Dissertation Advisor: Bruce McConachie, Professor, Theatre Arts

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David J. Wright, PhD

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In recent years, ubiquitous computing has altered traditional performance spaces. Arts organizations have notably tested various strategies to either accommodate or eliminate the persistent and disruptive "glowing screen" of smartphones. While theatre and performance artists and scholars correctly identify many problems created by this influx of new technology, this dissertation argues that the rise of ubiquitous computing presents immense potential for theatre and performance studies to begin solving the design problems faced by computer scientists and user experience designers. Theatre and performance scholars hold a crucial role in ubiquitous technology design for live performance, and we have key knowledge of action that user experience designers seek now more than ever.

I propose that human action is the basis for a common nomenclature and theoretical bridge between user experience design and theatre and performance studies. I extend Aristotle's intentionalist mimetic theory using current philosophy of action and cognitive science, and argue that performance artists and designers select and align flows of intentionality in action that immerse spectators in the intentional presentation of an action. Furthermore, I follow Elizabeth Anscombe's theory of action to argue for the incommensurability of propositionally articulated theoretical knowledge and non-propositional practical knowledge. Audiences experience the flow of a performance as they ascertain the interweaving of these incommensurable yet complimentary

articulations of intentionality through a reciprocal feedback loop of active perception. Both performers and audiences derive the meaning of a performance from an "expanded description" of the teleological structure of actions that comprise it. This action-centric analysis of performance provides the basis for dialogue with human experience designers through an ecologically balanced mapping of the four Aristotelian causes of a performance onto the design of new technology.

As a practical application of this theoretical framework, the dissertation also proposes a new platform for smartphone-based audience interactivity at live Jazz concerts. Applying the theoretical argument to the intentional flows of action in live jazz, the Nymbus system seeks to align the material, formal, and efficient causality of smartphones at concerts with the intentional flows in jazz performance in order to heighten and compliment audience immersion in jazz performance flow.

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PREFACE

A great many people gave a great deal in order to see this dissertation through to completion. I would like to thank my advisor, Bruce McConachie, for having the foresight at the start of this project to send me back to the drawing board. It became a much stronger argument because of it, and I became a stronger scholar. I would also like to thank him for his pioneering work in the Cognitive Science of Theatre and Performance Studies. My greatest theoretical regret in this dissertation is the small use I have made of cognitive science relative to my initial desires. Bruce's willingness to explore new theoretical directions has proved invaluable to this dissertation and his work has shaped my own in countless ways. I would also like to thank my committee: Brett Ashley Crawford, Jennifer Waldron, and Ryan McDermott. Their enthusiasm for the project was a recurrent source of encouragement when I feared that I had deftly navigated into obscure and quickly evaporating conceptual backwaters. Jen and Brett's early advice has proven to be immensely helpful. Ryan has also provided excellent, informal advice on the project from its infancy. I am very grateful to him for agreeing to take up the discussion again in the final hours of its completion when prospectus committee member Kathy George was forced by family illness to step down.

I would like to thank Pittsburgh's Idea Foundry, and especially Garry Gardiner, for providing the funds and guidance needed to build the prototype of the Nymbus platform. Pittsburgh's entrepreneurial community as a whole has been an invaluable source of connection and support throughout the development process. Idea Foundry had the guts to give a theatre student enough monetary support to actualize a nebulous, futuristic expanded description of concert experiences. The University of Pittsburgh's Innovation Institute has also been incredibly

supportive. Babs Carryer, a theatre-artist-turned-entrepreneur at the Institute, was patient enough to see the business potential of Nymbus and to help me hone the pitch and secure a second place prize at Pitt's Randall Family Big Idea Competition.

The Nymbus team as a whole; Nicholas Amoscato, Matthew Beck, Martin Potoczny, Jason Brahim and Chris Norville are amazingly talented and committed to the idea. In relation to this dissertation, I am especially grateful to Nick and Matt. Nick is astounding. Not only does he have the artistic and musical practical knowledge needed to make invaluable design contributions, he has the technical skill needed to build the platform. Most of the elegant application renderings included in this dissertation are Nick's work. I am honored to have Matt on the team. His deep technical know-how and careful attention to the details of the project brought about the re-designed data model and cueing synchronization described in this dissertation.

I now reach the most difficult portion of this preface. I cannot adequately thank my family. Writing this dissertation has been the most difficult thing I have ever done, not simply because of the difficulty of the task in its own right, but also because of the demands it placed on those I love most dearly. My parents, Bill and Sarah Wright and Don and Margaret Pooley, have been astounding sources of encouragement and support. Despite setbacks and repeated underestimates of time required to complete this project, they never waivered in a profound demonstration of unconditional love. My brothers, Matthew, Joshua and Cody have also provided constant encouragement. Matthew especially, having himself trod this lonesome valley, provided insight and practical wisdom at key moments in the process. I thank you all.

I am intensely grateful to my wife, Lynn, and children, Grace and Sheldon, for graciously persisting with me through this journey. They patiently awaited the completion of this work and

for it sacrificed numerous evenings, weekends, rest and joy together as a family. In it all, they managed to inspire me every day to press on. Gracie, my “papers” are finally done.

To Lynn, I dedicate this dissertation. It’s a paltry gift for her years of love and sacrifice. If a dissertation is meant to demonstrate excellence, let the reader know that the chief excellence demonstrated hereby resides solely in her.

Non nobis, Domine, non nobis,

sed nomini tuo da gloriam.

1.0 AN INTRODUCTION TO THE CURRENT USE AND BEGINNING TRANSFORMATIONS OF EMERGING TECHNOLOGIES IN PERFORMANCE

Momentous performance disruptions are common throughout theatrical history. Riotous, drunken Greeks were ejected from the theatre of Dionysus. Elizabethan actors had to match and out-play a variety of disruptions with good humor, spontaneity, and creativity. Alfred Jarry's *Ubu Roi* and Luigi Pirandello's *Six Characters* inspired riotous discontent among audiences. The Astor Place Riots arose in a day when national sympathies coupled with actor preference proved to be a deadly combination. The Playboy Riots ignited when theatrical representation conflicted with national, religious conviction.

A new and distinctly different form of disruption has recently appeared within a variety of performance forms as audiences quietly raise the ubiquitous "glowing screen," bewildering and often outraging performers. The conflict between performers and audiences has progressed from occasional disturbances and quiet discontent, to frequent disruptions and polite reminders, to particularly egregious infractions and show-halting outbursts by performers. Recently, actor James McAvoy brought a performance of *Macbeth* at Trafalgar Studios in London to a halt when he began yelling at an audience member. The Scottish actor, critically acclaimed for film acting, objected to amateur filming of his live performance.[1] Such occurrences are increasingly common.

[1] Joel Gunter, "James McAvoy Halts Macbeth to Stop Audience Member Filming," Telegraph.co.uk, April 8, 2013.

Hugh Jackman in a performance of *A Steady Rain*, the late Richard Griffiths in *History Boys*, Kevin Spacey in *Richard III*, and Laurence Fishburne in a revival of *The Lion in Winter* have all earned media attention by pausing performances in order to combat cellphone disruptions. Patti LuPone is reportedly a formidable force in this battle with audiences.[2] During her penultimate Broadway performance of *Gypsy*, LuPone halted "Rose's Turn," and brought the houselights up in order to eject a picture-taking audience member from the theatre. The audience cheered, but ironically, the entire incident was recorded on another audience member's cellphone and subsequently posted on YouTube.[3] During the incident, LuPone instructed the audience, "I have to say this: We have forgotten our public manners. And we have forgotten that we are in a community and this is the theatre, and all of you, every single one of you, except for that person, has respect. And I and the rest of the company appreciate it. Thank you." However, to compile the irony, cameras flashed again at the following performance, but this time *after* LuPone had belted the same musical number. LuPone confided in a Playbill interview,

> I felt like a rock star…There's no other way to put it. At that point there were so many cameras going off, I felt like, 'This is what Bruce Springsteen must feel like! This is what Janis Joplin felt like!…It was life imitating art imitating life in 'Rose's Turn.' Patti getting the applause, Rose getting the applause. It was wild! It was Rose taking the bows, it was Patti taking the bows. It was Patti going crazy, it was Rose going crazy. You know what I mean? It was truly a celebration of that number, and I felt like a rock star. All of a sudden, at the end of it, the cameras started, and they went from the orchestra up to the mezzanine and the balcony. It was wild. I wish I could have gotten a picture of that. I think my husband turned around and was like, 'Holy sh**!' It's something that doesn't happen in the theatre, and it was a moment I'll never forget.[4]

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[2] David Ng, "Five Crazy Cellphone Disruptions in Classical Music and Theater," Culture Monster, January 12, 2012, http://latimesblogs.latimes.com/culturemonster/2012/01/five-crazy-cellphone-disruptions-in-classical-music-and-theater.html.

[3] DivaBehavior, *Patti Lupone Stops "Gypsy" Mid-Show to Yell at a Photographer*, 2009, http://www.youtube.com/watch?v=WruzPfJ9Rys&feature=youtube_gdata_player.

[4] Andrew Gans, "DIVA TALK: Catching Up with Two-Time Tony Award Winner Patti LuPone," Playbill | Celebrity Buzz: Dival Talk, February 27, 2009, http://www.playbill.com/celebritybuzz/article/126786-DIVA-TALK-Catching-Up-with-Two-Time-Tony-Award-Winner-Patti-LuPone-.

The two incidents are simultaneously enlightening and bewildering. As with other aspects of live performance, timing is everything. It seems that phone use during a performance per se is not as problematic as when and how the phones are used. Furthermore, phone use in the first instance drew LuPone into solidarity with the audience around the traditional theatrical art form. The incident on the following evening was an instance of artistic border-crossing, and an entirely new, emergent experience. But with a career in both concert performance as well as theatre, LuPone herself practices a similar type of border-crossing. Beyond theatre, phones disrupt and even halt classical music performances, and popular music artists, whose performance styles frequently overwhelm the occasional phone call, have also voiced a troubled relationship with phones in the audience.[5] While some artists and music festival administrators attempt to ban cellphone usage during concerts, others leverage filming, texting, tweeting and facebooking by fans as crowd-sourced publicity.

We are all well aware of the distraction that a phone ringer brings to our focused attention on a skillfully crafted performance. In the classical music and theatrical performance community, our response to this challenge has almost universally focused on ways to prohibit, inhibit and otherwise eliminate an audience's use of their mobile devices. More often than not, we conclude that the blare of the ringer, the glow of the screen, and the intrusion of third-party conversations via Twitter and Facebook interfere with the purpose of performance. We attempt to creatively, wittily, and adamantly disabuse audiences of the mistaken belief that "unplugging" for a few hours will compromise their enjoyment of a performance. Yet, the problem is more complex, the solution not so simple. We repeatedly fail in these attempts. A significant contingency of audience members

[5] Stephen Thompson, "Are Bands Right To Scold Fans With Cellphones?," The Good Listener, August 1, 2013, http://www.npr.org/blogs/allsongs/2013/07/31/207686810/the-good-listener-are-bands-right-to-scold-fans-with-cell-phones.

would rather risk a whispered confrontation with a house manager (or worse in some cases) than power down their mobile device. Another contingency merely forgets to silence their phones, despite repeated appeals made prior to the dimming of houselights. Other audience members may not know how to silence or shut down their phone and may simply not hear its performance-disrupting ring.

In addition to this apparent phone fetish and confusion among audiences, the rapid rate of technological development forces us to wonder if we are losing the battle to train audiences in proper phone etiquette. Audiences were receiving phone calls in the early 1990's and less intrusive text messages in the late 1990's. By the late-2000's, Twitter and Facebook feeds gave audiences a constant, silent, ambient awareness of social interactions beyond the walls of live performance spaces. These social feeds still introduce the "glowing screen" into performance environments, but the trend towards smart watches and other wearables may soon lessen or eliminate altogether our complaint against luminous distractions. Heads-up displays are another example of wearables that will doubtlessly lessen the obtrusiveness common Internet interactivity running parallel with live performance. Google's recently failed attempt to popularize the Google Glass will doubtlessly be followed by less socially awkward heads-up display devices.[6] The Glass project is merely one example of the work being done in human-computer interaction that seeks to seamlessly integrate

[6] While these heads-up displays appear clunky and ominously Orwellian to some, Google's chosen tag line for the project was "Getting Technology out of the Way." It is doubtful that they have achieved this goal by some standards; the product makes the search giant's primary product, information, constantly "in the way." However, phenomenologically speaking, the glasses do seem like an honest stab in the direction of "Getting Technology out of the Way." Nonetheless, several states are already working toward banning them while driving. In the interest of public safety, this seems a wise and somewhat urgent move as wearable heads-up displays are still a relatively experimental domain with a number of competitors near market. "Google Glass."; Betsy Isaacson, "5 Alternative Heads-Up Displays That Aren't Google Glass," Huffington Post, March 4, 2013; "Virtual Reality Contact Lenses Could Be Available by 2014," TechNewsDaily.com, accessed March 25, 2013. The recent discontinuation of Glass for retail production illustrates the steep challenges to be overcome in this area, but the determination of Google, Microsoft, Facebook and others to popularize heads-up displays should give pause to any uncritical dismissal. See Mesco, "Italian Eyewear Maker Luxottica Working on New Version of Google Glass, CEO Says," April 2015; Microsoft, "Microsoft HoloLens"; Oculus VR, LLC, "Oculus Rift - Virtual Reality."

developments in computer science into daily life. Glass and similar products may seem like gimmicks to some, products developed for a technology-fascinated, consuming culture. Undoubtedly, profit is a part of the motivation behind these products, but they also exemplify many of the major research questions entertained by those working in the domains of Human-Computer Interaction and Artificial Intelligence. The advertising campaign and public statements made by Google founder Sergie Brin promoting the Glass project emphasize the device's ability to turn the user's bodily posture and awareness up away from a phone screen in active engagement with her surroundings, thereby making Internet information and connectivity more seamlessly integrated into our natural function as agents in the world.[7] The device is a step forward in Google's development of Artificial Intelligence that "intuits" and automatically supplies information that an agent may be lacking or searching for within an environment. The end goal for Google's co-founders is reportedly a computer chip embedded in the brain that seamlessly supplies information "as it is needed."[8] The days of noisy and light polluting phones may be numbered, but it is doubtful that the propositional form of the information provided by the Internet search giant will change much. The problem is not going away; it is merely getting more complex.

[7] Sergey Brin, "Sergey Brin: Why Google Glass?," February 2013.

[8] Ian Burrell, "Inside Google HQ: What Does the Future Hold for the Company Whose Visionary Plans Include Implanting a Chip in Our Brains?," The Independent, accessed January 28, 2014, http://www.independent.co.uk/life-style/gadgets-and-tech/features/inside-google-hq-what-does-the-future-hold-for-the-company-whose-visionary-plans-include-implanting-a-chip-in-our-brains-8714487.html.

1.1 CURRENT PAIN & CURRENT SOLUTIONS EXAMINED

These factors, audience insistence and technological development, have no doubt contributed to theatre and performance artists' attempts to embrace this developing field. Beyond standard social media marketing campaigns, theatres and symphonies have introduced “tweet nights” and “tweet seats” in which audiences are free to use their phones during select performance nights or within restricted segments of the audience. We have seen entire Twitter performance of full-length plays, for example *Such Tweet Sorrow* by the Royal Shakespeare Company in collaboration with the Muldark cross-platform production company. The management of the Broadway hit *Next to Normal* launched a twitter performance of the play as a marketing stunt intending to buoy up the sinking fortunes of the show. It worked. Fans became so engrossed in the Twitter performance that they continued to follow it while simultaneously viewing live performances of the play. Some of these attempts at harmony with emerging technology have been more successful than others, but all too often even the “successful” attempts to embrace audience use of emerging technology within a performance environment proceed upon theoretical and practical lines that privilege technology over performance art forms.

Many recent attempts to “incorporate” existing or emerging technologies and media into live performance proceed by making those new technologies integral to the performance itself. These experiments often fall within the broad category of multimedia performance and almost always take the form of on-stage technologies. Multimedia performance could be traced to the earliest technological “interventions,” such as the *deus ex machina,* trap doors, and pageant

wagons,[9] but Christopher Baugh has helpfully distinguished between two distinct types of multimedia performance. The first employs technologies on stage to serve an "end" within the performance. The *deus ex machina,* for example, augmented the representation of divine presences on stage; stage lighting not only renders visible, but also sculpts and frames performers; the Pepper's Ghost illusion creates the appearance of supernatural apparitions. Baugh's second classification of multimedia performance self-reflexively employs technologies as "ends in themselves."[10] Artists create hybrid performance forms that intentionally sublimate the "bare" subjectivity of performers into a machine aesthetic in which performers work with and through technology. The exact nature of this sublimation is open to further classification. Some uses of technology as ends in themselves involve physical implants or piercings of the performers body; others examine the human/technology meld metaphorically, but both fall under a form Jennifer Parker-Starbuck has dubbed "Cyborg Theatre."[11] Much of this work seeks to examine the way that technology has altered our lives either ontologically or experientially. Both of these approaches, while appearing to shape technologies to the demands of a particular performance, actually privilege technology by conforming a performance to the demands and capabilities of whatever technology or set of technologies are used.

Gaming culture is another point of intersection between technology and theatre and performance studies. Theatre and performance studies (as well as artists) have had a significant impact on the design and development process behind these games. Additionally, theatre and

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[9] See for example Steve Dixon's excellent *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* (Cambridge, Mass: MIT Press, 2007).

[10] Christopher Baugh, *Theatre, Performance and Technology: The Development of Scenography in the Twentieth Century, Theatre and Performance Practices* (Basingstoke [England] ; New York: Palgrave Macmillan, 2005).

[11] Jennifer Parker-Starbuck, *Cyborg Theatre: Corporeal/technological Intersections in Multimedia Performance* (New York: Palgrave Macmillan, 2011).

performance artists have taken up residence directly within massively multiplayer online games (MMOGs), establishing performance troupes with impressive production histories. Avatar Repertory Theatre (ART), for example, has been performing since 2008 and boasts "...20 or so actors, writers, graphic artists, programmers, musicians, sound engineers and production administrators".[12] ART's full-length productions are mounted principally on *Second Life* among other MMOGs, and the troupe opens weekly "workshops" to public viewing. This is but one example of a growing and already robust culture of "Virtual Theatre," which has been categorized under the general heading of "Intermedial Performance."[13] Many of the uses of technology discussed above are thought to be intermedial—that is, involving the combining and fusing and interrelating of various media, often with "self-conscious reflexivity."[14] While the theoretical approach I wish to take will lead to points of disagreement with those using intermedial paradigms, my focus on spectator engagement in performance through technology could easily be seen to fall within the intermedial purview. However, in a very real way, this project is decidedly not intermedial. Whereas intermediality pertains to the blending of various media in order to create "new modes of representation" that lead to "...new perceptions about theatre and performance and to...new cultural, social and psychological meanings in performance,"[15] I would like to argue that the solution to the disruption of performance spaces brought by ubiquitous computing should arise out of a deep understanding and appreciation of established modes of representation, proven perceptions of bodies in time and space and the relations between the two. Importantly, throughout this dissertation, I want to build the argument that, cognitively speaking, the means by which we

[12] "Home | Avatar Repertory Theater." See also "The SL Shakespeare Company: Homepage."
[13] See Giannachi, *Virtual Theatres*; and "Welcome to Central's Research Centres."
[14] Chapple and Kattenbelt, *Intermediality in Theatre and Performance*, 11.
[15] Ibid.

comprehend the meaning of the actions in a performance—which forms the substrate of any significant awareness of bodies, time, and space—are not so easily disrupted by the simple inclusion of new media within a performance. There is, so to speak, a deeper magic behind the simple, organic perception of intentional actions, which cannot be easily broken by modern, technological wizards.

Certainly of merit in many respects, all of above-mentioned intermedial approaches to technology in performance have a significant limitation. All too often, they place theatre and performance studies in service to emerging technologies, subvert the demands of the live to the demands of the mediated, augmented, and virtual, reshaping live performance to meet technical constraints as much or more than these constraints are shaped to serve live performance. Additionally, most of these applications of technology require performers to perform with and through a new set of tools. Finally, these approaches to symbiosis between technology and live performance underestimate the potential contribution that theatre and performance as objects of study and fields of practice can make to the rapidly expanding field of User Experience Design (UXD) of new technology. I propose that rather than using new technology in performance, performing "with" technology, or searching for new, hybrid and emergent performance forms arising as emergent technologies alter our daily modes of communication and interaction, we should acknowledge that the current technological disruptions we find in performance spaces have been meticulously *designed*, but designed for use in a context that has little to do with live performance. However, user experience designers often work in concepts and terms that are delightfully familiar to performance artists and theorists, and we actually have much to contribute to the design of that technology for use both inside and outside of performance. The key to this

contribution lies in the fact that both user experience designers and performance professionals observe, parse, create, test, and iterate upon the context and execution of human action.

1.2 THEORIZING, DESIGNING AND IMPLEMENTING NEW DIRECTIONS

UXD has increasingly entered public awareness as computers, mobile devices, and the Internet alter our work, play, social interaction, and educational practices. As a design field, UXD sprang out of early work in Human-Computer Interaction (HCI), which began in the 1960's as computational technologies became sophisticated enough to allow engineers to expand their focus beyond merely making computers function correctly. Apple's Graphical User Interface (GUI), appearing in the early 1980's, marked a pivotal moment in this field of design as computational modeling and processes became aligned with much older, artifactual and spatial forms of human action and conceptualization.[16] Apple has continued its legacy of innovation in this area, and the recent legal "smartphone wars" have revealed the complex web of intellectual property rights and financial importance associated with UXD.[17]

While much of the legal dispute in these cases is popularly understood to revolve around similarities of GUI between smartphones, Dan Saffer in *Designing for Interaction: Creating Smart Applications and Clever Devices* argues that human interaction with and through technology now includes much more than merely user interfaces.[18] The interface first became important when dials, switches and the command-line interface replaced older methods of information input, such as

[16] Saffer, *Designing for Interaction: Creating Smart Applications and Clever Devices*, 12.
[17] Williams and Safiullah, "The Smartphone Patent Wars."
[18] Saffer, *Designing for Interaction: Creating Smart Applications and Clever Devices*, 11–18.

punch cards. However, complexity of interaction grew with technological innovation. In the 1990's the World Wide Web created a growing number of connections between users. Later, as devices became smaller, sensor-laden, and integrated into other machines, such as cars and household appliances, users were presented with new ways of interacting with their immediate environment on a moment-by-moment basis. The increasing speed of processors and data-transfer rates created near real-time interactions between users through devices. This development from interaction with devices to interaction with others and one's environment through devices in real-time led to the field of design now known as Interaction Design (IxD).

HCI and IxD are conceptually distinct types of design, but many of the concerns that these two schools address are overlapping. Saffer, for example, visualizes the intersection of HCI and IxD in a Venn diagram and encompasses this intersection within the broader category of UXD, which also includes Information Architecture, Communication Design, and User-Interface Engineering along with elements of other design categories.[19]

[19] Ibid., 17.

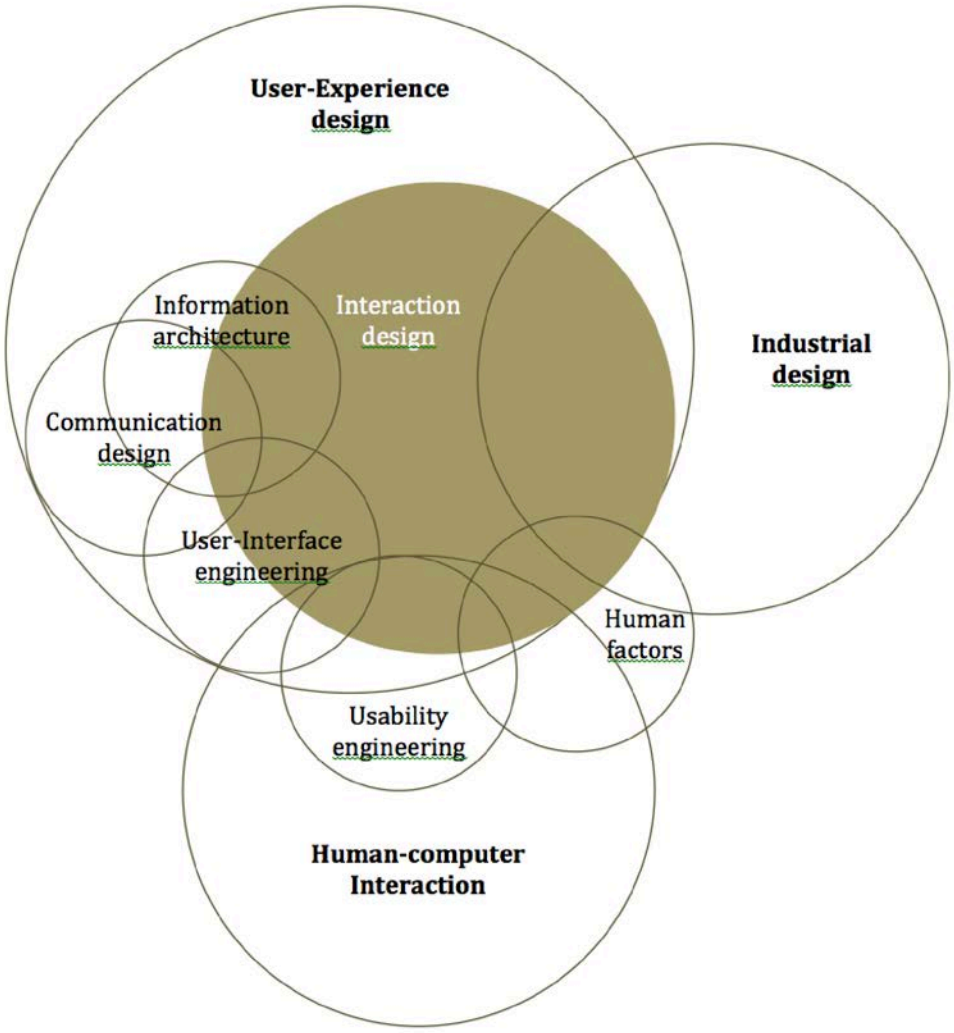

Figure 1.1: Re-creation of Saffer's "The overlapping disciplines of interaction design."

Many of the factors generating overlap among these various domains of design arise from the fact that they all directly or indirectly examine human action and the environment in which it occurs. As outlined above, the development of computer technologies follows a pattern of interchangeably allowing and demanding increasingly complex interactions between individuals. Web 2.0 transformed static websites into dynamic platforms for interactions between users; ubiquitous computing has brought that interaction pervasively into our moment-by-moment interactions in real space. As Saffer argues,

> We've entered the era of interactive gestures. The next several years will be seminal years for interaction designers and engineers...we will design new ways of interacting with our devices, environment, and even with each other. We have an opportunity that comes along only once in a generation, and we should seize it.[20]

According to Saffer, this unique opportunity for interaction designers has arisen due to new sensors within devices, faster processors, new modes of input, and (most recently) improvements in battery power. Designers have had a paradigm shift, now focusing on the whole human body moving in space rather than solely the manipulation of the GUI.

Those working in design have long realized the importance of the arts to their work. Interactive storytelling has become a hallmark of HCI and forms a key component in the design of video games and simulated environments.[21] In addition to this focus on narrative or "Interactive Dramaturgy," theatre and performance studies specifically have an important and growing history in HCI and IxD. One of the key figures working in interaction design, Brenda Laurel, has a background in theatre and wrote the IxD classic, *Computers as Theatre*.[22] Laurel's use of theatre concepts, particularly drawing on Aristotle's *Poetics*, demonstrates the past and current conceptual cross-pollination between theatre and user experience design. Her early conceptual work in IxD has matured into the actual incorporation of theatrical practices in the design process.[23] In this dissertation, I wish to leverage existing action-centric design principals to argue for a more robust, common nomenclature and theoretical approach between performance studies and the design of ubiquitous computing and emerging media for use within performance spaces.

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[20] Saffer, *Designing Gestural Interfaces*, 3-4.

[21] For example, see Hagebölling, *Interactive Dramaturgies : New Approaches in Multimedia Content and Design*; and Murray, *Hamlet on the Holodeck : the Future of Narrative in Cyberspace.*

[22] Laurel, *Computers as Theatre;* "Brenda Laurel." Laurel holds an MFA and a PhD in Theatre from Ohio State University. Her dissertation proposed the design of a "Computer-Based Interactive Fantasy System."

[23] Sonic Interaction Design seems particularly strong in this area. See for example, Pauletto et al., "Integrating Theatrical Strategies into Sonic Interaction Design;" Hug, "Investigating Narrative and Performative Sound Design Strategies for Interactive Commodities."

This dissertation first develops the common nomenclature and theoretical approach to design of ubiquitous technology for performance spaces, then it applies those design principals to the design, construction and partial testing of an interactive platform for live music concerts. This platform, called Nymbus, enables musicians to create interactive experiences *with* their audience using audience smartphones. While theory comprises the lion's share and serves as the backbone of the dissertation; the development of Nymbus provides an important practical application of the theory that will further refine the theory and provide additional ground for its assessment. This structure of the whole project, theoretical development followed by practical application and testing, is decidedly oriented toward performance studies rather than theatre studies. I believe that theatre arts could benefit from this work on audiences and interactivity, but given the current reticence of most theatre artists and scholars to allow the use of cellphones within performances, building and testing Nymbus for an alternate performance form seems prudent. Furthermore, there are a number of positive reasons to build the system specifically for use within music concerts.

First, theatre has traditionally dealt in in propositional knowledge transfer whereas music is predominantly a non-propositional art form. This is not to insinuate that theatre is *solely* a propositional art form whereas music is non-propositional. On the contrary, both theatre artists and musicians are often must appeal to metaphor or demonstration when attempting to convey the meaning of a performance. No theatre or musical critic, no matter how superb her analysis, would attempt to convince her readership that the work of criticism is an adequate substitute for an experience of the live performance itself. Nonetheless, because we intuitively comprehend music as a non-propositional art form, albeit occasionally coupled with lyrics, music is a perfect domain to begin re-conceptualizing the use of ubiquitous technology in live performance settings. Given that smartphones are already used in performance settings for texting, tweeting, web surfing and

other highly propositional activities, building for a non-propositional performance form will force me to find creative ways to build an audience/technology symbiosis. Solutions that solely deliver audiences propositional information, such as dramaturgical notes on a production or text answers to questions posed by the performance, do not perfectly transfer to music. As I see it, music is the ideal incubator for developing non-propositional, performance-complimenting, interactive technologies for audiences. This practical know-how would greatly inform the later use of Nymbus in theatrical settings.

Second, building for music opens up the potential to focus particularly on the interactive qualities of jazz performance. The improvisational qualities of the genre bring an emphasis on group collaboration and call-and-response patterns. Improvisational interactions with other performers and the audience can greatly influence the dynamic development of jazz music. Not only is this theoretically a reason to study the interactive qualities of jazz, I have also been delighted by the positive responses I have received to this particular project by jazz musicians. If music is the ideal incubator for the development of non-propositional methods of interacting with devices by audiences, it seems that jazz is an ideal genre for developing interactivity between audiences and performers. Furthermore, this focus on audiences in music concerts, and jazz particularly, still keeps this dissertation well within the purview of theatre and performance studies. For examples of work at the intersection of music, theatre, and performance, we need look no further than David Savran's *Highbrow/Lowdown: Theatre, Jazz, and the Making of the New Middle Class* or David Pattie's *Rock Music in Performance.*[24] Finally, it is noteworthy that funding to build the system for music concerts has become available whereas funding for theatrical uses has not.

[24] Savran is, of course, well known in theatre studies; Pattie is a reader in Drama and Theatre Studies at the University of Chester, UK. David Savran, *Highbrow/lowdown: Theater, Jazz, and the Making of the New Middle*

1.2.1 Three Reasons for the Timeliness of the Project

If theatre and performance scholars are to engage User Experience Design with our knowledge of audience experience at live events, a robust theoretical argument is in order. Furthermore, such a theoretical approach is particularly fruitful for a number of reasons. First, as I have been framing the discussion in this essay, the incorporation of emerging ubiquitous computing into live performance introduces many questions concerning human cognition that interest both performance scholars as well as those working in UXD, emerging media, as well as artificial intelligence. Laying a theoretical groundwork for this dialog—determining how to frame the discussion, asking questions of interest to both sides of the dialog, establishing a common nomenclature—is essential. The recent cognitive turn in theatre and performance studies is an excellent place to begin that dialog. Given the universal applicability of questions of cognition across disciplines, indeed the apparent *necessity* of interdisciplinary dialog to resolve questions of cognition, cognitive science holds the potential to become a sort of *lingua franca* between performance and technology. The challenge lies in fully conceptualizing this common discourse in a way that resonates with the objectives of these disparate disciplines. Fortunately, cognitive science has developed since the 1970's in a way that aids the process of charting this conceptual resonance.

A second reason why this theoretical discussion is needed arises out of the apparent disagreement among scholars in theatre and performance studies over what, ontologically

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Class (Ann Arbor: The University of Michigan Press, 2009); David Pattie, *Rock Music in Performance* (Basingstoke, Hampshire [England]: New York, 2007).

speaking, constitutes a live performance. Phillip Auslander has issued an ontological challenge to live performance in the face of technological developments and alterations in performance practice.[25] This challenge has sufficiently blurred the distinction between live and "mediatized" performance for some, resulting in what might appear to those who accept Auslander's work to be inescapable technological reflexivity in my particular project. Arguing for the further incorporation of new media into theatre and performance in a way that privileges the unique contribution of performance to the design of that media must therefore demonstrate a clear way out of the "liveness" debate. Additionally, much current work in performance studies is quite comfortable with a very fluid definition of "Performance" that includes both actions and objects, possibly failing to distinguish between the two.[26] A project that seeks to examine UXD from the standpoint of live performance requires clarity as well as fecundity in its definition of performance. I propose that the concept of human action is central to this definition. Not only does action have a long conceptual history in the study of performance, questions of action frequently surface within cognitive science, thereby providing a conceptual key to forming a common discourse with computer science.

Finally, making a theoretical argument for the integration of performance and emerging technology based on the conceptual analysis of action and its role in cognition positions us to make the claim that UXD and human-computer symbiosis cannot be effectively accomplished *apart* from the study of action in praxis. In effect, performance theorists are not only aptly placed to enter the dialog in ubiquitous computing and UXD, the project as it pertains to technologized audiences cannot effectively proceed without them. This argument turns on what philosopher

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[25] Philip Auslander, *Liveness: Performance in a Mediatized Culture* (London; New York: Routledge, 1999).

[26] See for example the opening chapter of Richard Schechner, *Performance Studies: An Introduction* (London ; New York: Routledge, 2002).

Elizabeth Anscombe has claimed to be Aristotle's most significant contribution to Western philosophy, the idea of Practical Knowledge.

1.3 CRITICAL METHODOLOGY: ACTION AT THE INTERSECTION OF COGNITIVE SCIENCE, PERFORMANCE, AND TECHNOLOGY DESIGN

There are potentially many different ways to conceptualize the interface between cognitive science and performance studies in a way that will aid in the creation of technology that compliments live performance. However the particular conceptual bridge that I want to use relies on intentional action as its locus. Action has historically been a central concept used within theatre and performance studies, and has proved to be an effective way to understand the unique qualities of live performance. In the course of my argument, I will examine what has come to be known as the "Standard Theory" of action proposed by Donald Davidson. Davidson's theory holds an affinity with traditional, representation theories of mind, which arguably confront significant problems and are currently opposed by embodied and extended theories of cognition. An alternate theory of action developed by Elizabeth Anscombe is consistent with much of embodied and extended cognition, and will shape the theoretical architecture that I will use to identify points of symbiosis in the design of ubiquitous computing for audiences engaged by and with performance. Briefly stated, using Anscombe's theory of action, I will argue that when viewing a performance, audiences identify a variety of flows of intentionality. These flows of intention are in the structure of the actions within the performance, and they are apparent in the visual and aural design elements that serve as the setting in which these actions occur. Performance art is a careful selection and presentation of these intentional flows for the sake of contemplation by an audience. Identifying

and contemplating these intentional flows is itself a complex process due to the fact that humans have a multiplicity of capacities to apprehend the intentionality of an action. Said differently, an audience member will simultaneously identify several incommensurable *articulations* of intentionality that explain a performative act. Our ability to "get at" the intention of an action through these multiple articulations greatly improves the likelihood that we will accurately identify the intention of an act, while also providing performance artists fertile ground for creativity in the manipulation of these articulations. Designing computer-based interactions for the performance context involves first identifying these flows of intentionality through their various articulations and then aligning the intentionality of the technology with these performative, intentional flows.

The intentionality of action is hardly a foreign concept to performance artists and scholars. It is the starting point of much actor training and work. Actors are taught to search for their "objective," to ask "why" they are given a line or a movement. We also search for the objectives of scenes and design settings to create space that provides potentials for action that complement those objectives. Our approach to this type of analysis of intentionality usually draws upon folk psychology for its identification of the objective driving each action. We ask, "What does the agent know and believe about the situation she is in?" "What does she feel?" "What does she desire?" In effect we translate as best we can the intentionality of the act into propositional content that can be expressed with a given syntax and semantics. As a collaborative and often literary art form, a propositional and text-centric approach to performance is entirely natural and necessary. But theatre and performance artists are often quick to point out the difficulty of capturing the art entirely in propositional terms. The intentionality of action is recognized to extend beyond our ability to translate it into propositional content alone.

1.3.1 Action and Embodied Cognition

This philosophical analysis of intentional action holds much in common with current theories of embodied and (possibly) extended cognition. A recurring problem for representational, language-of-thought models of cognition arises in the apparent inability of these models to answer the "Frame Problem." This problem arises when using formal logical representations to drive actions in artificial intelligence. This model often fails because an artificial intelligence must act within a given environment or frame.[27] Doing so requires a complete knowledge of that world and an updating of information about the world as the intelligence acts on it and the world reciprocally "reacts" over time. Frames are linked to an environment and can change as we move about the environment.[28] Embodied and extended cognition contextualize cognition within an environment thereby including frames in their cognitive model. Similarly, intentionality references the environment in which action occurs.

Embodied cognition likewise locates the world and our interaction with it at the site of concept building.[29] Current work in performance and cognition makes effective use of work in conceptual acquisition via image schemas. The account of intentionality I propose to use is consistent with much of this work. These are only a few of the areas of overlap and consistency. It may seem that, in fact, intentionality is a nebulous concept that finds better expression and clarity

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[27] By "environment or frame" I mean the conceptual, material, and temporal entities with which the artificial intelligence acts and interacts. If the artificial intelligence does not "know" about corners and how to get out of them, then it will not function well within most human homes. If the intelligence is told to "measure out three kilograms of flour" but it is only designed to measure in pounds, then it will fail in the task.

[28] William Bechtel, "Introduction," Companion to Cognitive Science, 1999, 57, 61.

[29] See for example George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 2003).; George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought* (New York: Basic Books, 1999).; Francisco J. Varela, Eleanor Rosch, and Evan T. Thompson, *The Embodied Mind* (MIT Press, 1992).

in current work on embodied cognition; the contribution brought to the study of cognition and performance by the philosophy of action is minimal. But such a view overlooks the conceptual clarity brought by an analysis of intentional action, and additionally, the study of action provides a particularly fertile avenue for the analysis of performance. Particularly when applied to the integration of new technologies, intentional action helps clarify the relationship that we hold to the technological tools we use and the world in which we use them. Andy Clark argues that,

> The infant, like the [Virtual Reality]-exploring adult, must learn how to use initially unresponsive hands, arms, and legs to obtain its goals (for some detailed studies, see Thelen and Smith 1994). In so doing, the infant, like the Toddler robot, learns to make the most of the complex evolved morphology and passive dynamics of its own body…With time and practice, enough bodily fluency is achieved to make the wider world itself directly available as a kind of unmediated arena for embodied action… At such moments, the body has become "transparent equipment" (Heidegger 1927/1961): equipment (the classic example is the hammer in the hands of the skilled carpenter) that is not the focus of attention in use. Instead, the user "sees through" the equipment to the task in hand.[30]

However, Anscombe gives us good reason to think that we do not manipulate our bodies like we manipulate tools. We may intentionally pound with a hammer and write with a pen not only because hammers are designed for pounding and pens are designed for writing, but more importantly because hammers and pens present us with potential for grasping and grasping is something we do in order to pound and write. There is an internal, intentional structure to our actions that links our bodies to the world in which we act. “We” are not homunculi manipulating our bodies like we manipulate tools, and if we are capable of attaining virtuosity in the use of a tool to the point that it becomes “second nature,” the virtuosity is in the tool's design as well as in us—the tool is capable of doing what we want to do with it. If we lessen our attention to the tools we use when acting, they do not lose their place in our intentional rationality.

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[30] Andy Clark, *Supersizing the Mind*, Philosophy of Mind Series. (Oxford University Press, 2008), 10.

We can identify intentionality in many areas of cognition: emotion, perception, consciousness, and social interaction.[31] Rather than being replaceable and explicable in terms of these features of cognition, intentionality in action might be understood as the complex coupling of the various streams of intentionality identifiable within this matrix of cognitive components. Just as multimodal sensing ensures greater accuracy and efficiency of sensing, so also the intentionality of our actions and the actions of others is seldom (if ever) restricted to a single point of reference. Answering the "Why?" of action necessarily leads us to examine the state of the environment in which the agent is contextualized, the perceptual cues that the agent experienced, the actions leading up to the action under consideration, the emotional state of the agent, and the agent's perception of wellbeing or flourishing. Like so many other facets of the natural world that come equipped with multiplicity or duplication of life-sustaining processes and organs, our formation and apprehension of intention is no different. All of these aspects of intentionality coalesce to aid our accurate identification of the functioning and purposefulness of the world in which we live and the agents with whom we interact. Andy Clark explains that embodiment matters to human cognition, "…because the presence of an active, self-controlled, sensing body allows an agent to create or elicit appropriate inputs, generating good data (for oneself and for others) by actively conjuring flows of multimodal, correlated, time-locked stimulation. This trick promotes learning, bodily self-modeling, and categorization and may even (deep breath) hold out hope for grounded knowledge acquisition."[32] While Clark identifies the temporal correlation, we can also argue that there is intentional correlation; while he refers to the acquisition of theoretical

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[31] See for example, Martha C. Nussbaum, *Upheavals of Thought: The Intelligence of Emotions* (Cambridge University Press, 2003).; Lyons, *Approaches to Intentionality*.; Walter J. Freeman, "Consciousness, Intentionality, and Causality," in *Does Consciousness Cause Behavior?* (Cambridge, Mass: Mit Press, 2006), 73.; Bertram F. Malle et al., *Intentions and Intentionality: Foundations of Social Cognition* (Cambridge: MIT Press, 2001).

[32] Clark, *Supersizing the Mind*, 21.

knowledge, we can also argue that embodiment also leads to the acquisition of practical knowledge.

1.3.2 The Move from Action Theory to Technology Design

In order to use action theory to create human-computer symbiosis in performance, I would like to define performance as a carefully constructed action in which flows of intentionality are brought into alignment. Since technologies also have certain intentional flows, my goal is to align the intentionality of a technological device with the intentionality in a performance. This alignment has two outcomes. First, it aids in directing the audience's attention on the actions of performance in their complexity of meanings. Second, this technologically directed, focused attention on the performance presents audiences with potentials for action. The goal is to elicit audience interaction in a way that is derived from the particularities of live performance in general as well as the particular performance that the audience is attending. Importantly, these two outcomes are tightly interrelated. *Attending* to a performance is itself an active process that engages many cognitive faculties of a behaviorally passive audience member. Likewise, as audiences seize on potentials for action and become more actively engaged, their attention to the particularities of the flows of intentionality will increase.

This reciprocity of action and attention is recognized in multiple domains of cognitive science. Studies of efference copy show how sensory priming alerts the senses to impending bodily movements as they occur so that alterations in sensory inputs arising from bodily movements do not confuse the agent. Similarly, a feedback loop from the senses (reafference) updates the agent about the effects of bodily movements so that she can guide and correct those movements as they occur. Similarly, the systems approach to perception accounts for the way that sensation is

dependent on previously acquired knowledge and meaning, and Gibson's ecological account of perception argues that this knowledge is augmented through action within the environment.[33] Research in mirror neurons and behavior/movement expertise also shows how performance of an act can increase neural activity involved in the perception of another person performing that action—when neural efficiency would predict otherwise.

If performance is the careful construction of action so that intentional flows are brought into alignment, this careful construction (itself an intentional action) holds an intentional structure of presentation or showing. Said differently, the question of "why?" we align intentional flows of action at all is answered by the presentational or revelatory nature of this alignment. This presentational facet of performance creates dynamic relations between performers and their audiences that are often considered one of the defining features of live performance. While contemporary performance conventions often limit the amount of dynamic interaction between performers and audiences, the potential of these interactions always exists and often becomes the topic of conversation both backstage and in the house. If a technology is designed to give audiences actions that help them attend to the flows of intention in a performance, that technology also holds the potential to increase the level of interaction between performers and audiences. This interaction may form its own "feedback loop" in which performers adjust their performance in response to the actions of the audience, thus creating a dynamic system with properties closely resembling those studied in Dynamic Systems Theory (DST). Andy Clark directly draws this connection to performance when he argues that DST may provide a key answer to what he terms "continuous reciprocal causation" or CRC. He states,

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[33] Bechtel, "Introduction," 269–70; James Jerome Gibson, *The Ecological Approach to Visual Perception* (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1986).

> Think of a dancer, whose bodily orientation is continuously affecting and being affected by her neural states, and whose movements are also influencing those of her partner, to whom she is continuously responding! Or imagine playing improvised jazz in a small combo. Each musician's playing is influencing and being influenced by everyone else. CRC looks, in fact, to pervade the field of natural adaptive intelligence.[34]

Clark refers here to a dynamic system emergent between performers; however, a similar form of CRC could arise between performers and audiences, especially through a technology designed for interaction, or at least a technology designed to give audiences actions that align with the intentions of performers. DST may explain how interactive technologies work. It may also provide a key to understanding the reciprocal relationship between action and attention described above. There may be multiple dynamic systems in performance that could become increasingly robust through a technology aligned with the intentional streams inherent in a performance.[35]

Obviously, not just any action will align with the intentional flows within a performance. Technologically enabled interactions by audience members must be designed to achieve this alignment. Furthermore, we do not merely want to virtualize the actions that audiences already perform. If technological integration among audiences is to succeed, it must provide an *added* value to the experience either through heightened attention or through potentials for action not otherwise available to the audience. However, added value might include actions that are otherwise impossible due to cultural or physical restriction. So for example, social interactions are highly

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[34] Clark, *Supersizing the Mind*, 24.

[35] DST proves useful to my conception of the articulations of intentionality that form a flow of intentionality. Jeffery Elman, in "Connectionism, Artifical Live, and Dynamical Systems Theory," ed. William Bechtel, George Graham, and D. A. Balota, Companion to Cognitive Science, 1999, http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=44471&site=ehost-live, identifies six features that define dynamic system. All of these features may shed light on how the various articulations of intention I outlined in this dissertation may be distinct while nonetheless forming a cohesive flow of intention. First, the articulations of intention are interrelated—they "belong together" in non-trivial ways. Second, they cause changes to each other over time. Third, they all have an "attractor" or begin to align into a flow of intention in that they are directed toward a goal or end, which answers the "why" of an action. Fourth, their interactions generate a meaning that is understood as it unfolds as opposed to arising as the conclusion to a serial process. Fifth, these interactions among the flows of intention happen through multiple, simultaneous interactions. Sixth, a final, self-emergent structure arises from the articulations within their particular environment, namely the flow.

restricted in some performance forms, but audiences could nonetheless ignore these restrictions. The fact that it is possible for an audience member to ignore social restrictions and merrily chat with his neighbor for the duration of the performance (or until others around him tell him to "knock it off") does not render irrelevant virtual means of socializing during performances. Naturally, a virtual chat room must be designed to complement the performance or the social dynamic of performance forms; that is precisely the type of design challenge I wish to tackle. The limitations of virtualized actions that audiences already perform arise out of the realization that technology should focus attention and action toward the live performance space and time, not the virtual.

By understanding intentional flows we can better understand the actions that comprise a performance, which will in turn guide value creation through technological integration. This design problem can be conceptualized in the following way. Current cognitive theories of technology design map the logical and procedural steps taken to use an object.[36] These theories seek to design technology in such a way that interactors recognize the potentials for action latent within the object, presumably desire to use the object in the way and for the purpose for which it was designed, and receive immediate feedback when their actions fulfill or violate the intended use. This design strategy can be applied not only to objects, but also to workflows and organizational systems. However, with the proliferation of connected systems and devices, the interactions become exponentially more complex and dynamic. Consequently, designers must consider more than mere affordances and task structures, they must consider dynamically changing systems of action and interaction.

In order to manage the complexity of these design challenges, some designers are beginning to implement improvisational theatrical training and techniques in design sessions with

[36] See for example, Don Norman, *The Design of Everyday Things* (Basic Books, 2002).

stakeholders. The solutions that emerge from these design sessions are thought to unleash the inherent creative problem-solving potential of participants while simultaneously providing the context in which the particularities of the behaviors and motivations of those solutions become apparent.

The design aspect of my project is of a similar nature to this newly emerging design research methodology. However, I would argue that my philosophical argument makes an important contribution to interaction design methods. A conceptually precise understanding of action enables us to better parse particular problems of interaction design for live performance. Furthermore, it enables us to develop an approach to design that applies a more expansive notion of causality than is afforded by current theories of interaction design. Rather than conceiving of action as a linear, causal process in which beliefs and desires cause behavior within a given context, I use Anscombe's appeal to Aristotle's four causes (material, formal, efficient and final) to develop a robust understanding of live jazz performance as a causal manifold specifically designed to enable fluid, coordinated interaction and improvisation. In effect, I argue that live jazz is proto-interaction design of a very particular sort, namely, interactions designed from the musical, performer and environmental forms, materials and efficiencies (in the causal sense). This design paradigm maps very closely onto Passive-Dynamic Design currently used in artificial intelligence and robotics design. Consequently, I give the moniker "Passive-Dynamic Interaction Design" to my approach to design.

1.3.3 Intentional Flows and Articulations

I conceptualize intentional flows as differing articulations of the intention within an action. Said differently, these various articulations make sensible the application of the question "Why?" to the

action. Any single act can seem to have multiple intentions behind it. For example, one may play notes on a piano in order to play a song on the piano. Are these two different actions with corresponding intentions or two parts that comprise the internal, intentional structure of a single action, namely playing the piano? This is the problem of action individuation. Anscombe opts for the latter account in which actions have an internal intentional structure. One could also want to please one's teacher by playing the piano, but Anscombe argues that this is the reason *for*, not the intentionality *of* the action. It is a rational articulation of the intentionality within the action. There are other, similar articulations of intention that deepen and add complexity to our comprehension of the intention in an action.

We can identify intention through the multi-modal interplay of the perceptual faculties. Deaf musician Evelyn Glynnie, for example, describes how she had to learn to attend to the way that playing an instrument reverberated through her whole body, not just her ears.[37] Hearing, Glynnie maintains, is not limited to a single perceptual modality. Rather, our perception of the way that the sound is *made* references other modalities such as sight. Glynnie demonstrates how the sound that a percussionist creates on a snare drum is dependent on the way that she grips the sticks; much interpretative intentionality is conveyed through this somatosensory engagement with the instrument. Audiences can observe this intentionality visually through the way that a musician moves her body as well as aurally in the affect that this movement has on the sound generated. This type of modality integration, known as "binding," occurs laterally between the senses at multiple stages in the perceptual process as the various modalities "feed forward" sensory inputs, but there is also evidence that backward connections derived from knowledge of perceptual context

[37] Evelyn Glennie, "Evelyn Glennie: How to Truly Listen," February 2013.

can also affect sensory experience.[38] Similarly, in *This is Your Brain on Music*, cognitive psychologist and neuroscientist Daniel J. Levitin explains the importance of a musician's action on an instrument in creating the instrument's timbre. Levitin references the legendary 1950s "cut bell" experiments in which Pierre Schaeffer recorded a number of orchestral instruments and then cut the beginning attack phase of the sound from the tape. Listening to these instrumental recordings without the attack phase, most people fail to identify the instrument that was recorded.[39] Amodal factors such as rhythm, duration, shape, intensity, and spatial extent can also impact sensory experience, and by extension, our apprehension of the intentionality of an action. These considerations lend support to the intentional account of perception in which, for example, seeing is always "seeing as."

Emotions also articulate intentionality and have in recent years become an increasingly important component of UXD. Martha Nussbaum defends a eudaimonistic view of the emotions in which they are essential features of cognitive function, not "thoughtless natural energies" as they have historically been categorized. Nussbaum's teleological account relies on the idea that emotions are directed at an object; they display an intentionality that is closely integrated with the eudaimonistic flourishing of the person who has them.[40] On this account, emotions may be related to conceptual, propositional content, but emotions are also directly influenced by perception. Nussbaum argues, "Although emotions can in a sense be defined by their evaluative-eudaimonistic thought content alone, the experience of emotion usually contains more than that content. It contains rich and dense perceptions of the object, which are highly concrete and replete with detail.

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[38] Bechtel, "Introduction," 228–70.
[39] Daniel J. Levitin, *This Is Your Brain on Music* (Dutton, 2006), 50-52.
[40] Nussbaum, *Upheavals of Thought*, 27.

Thus, typically, grief is not just an abstract judgment plus the ineliminable localizing element: it is very richly particular."[41]

If perceptions and emotions display a strong connection to conceptual content, it should be apparent that there is also a conceptual articulation of intention. Davidson's causal account of action attempts to construe intentional action based on our ability to provide conceptual/speculative explanations of action. Anscombe insisted on the classical distinction between speculative and practical knowledge, making the latter irreducible to the former while reserving the explanatory role of conceptual thinking as a valid articulation of intention. The ease with which we provide conceptual articulations of intentional acts explains why Davidson and others have attempted to account for intention solely in terms of conceptual content. Yet, insisting that this conceptual articulation imperfectly approximates the intention we know practically does not negate the importance of inferential, speculative rationality about our own acts and the acts of others. For example, accounts of perception (perceptual articulation of intention) must examine the way that prior knowledge and belief (conceptual articulation of intention) affect our perceptual judgments. Ultimately, all of these articulations provide a more complete answer to the "Why?" questions. Why, for example, does the singer/songwriter repeatedly tilt her head back, raising the microphone vertically above her mouth at a particular point in the chorus during a live concert? We might be able to provide an inferential answer relating to the conceptual content of the song, but a more complete answer will also reference perceptual articulation involving multi-modal integration and the emotional upheaval elicited by that point in the song.

[41] Ibid., 64–5.

1.3.4 Three Preliminary Caveats

The theoretical approach I have proposed introduces a few points of possible contention. First, introducing a new technology into a performance will invariably alter that performance form to some degree. Regardless of the type of technology used or how closely the intentionality built into that technology aligns with the intentional flows already latent within a performance, the new technology will alter the environment in which the performance occurs. Because performances are actions of a particular sort and actions can only occur within an environment, altering the environment will alter both the actions selected for performance and the experience for audiences. It also alters the relationship and reciprocity between audiences and performers. (This point has also been illustrated by ornithologists' study of the differing sounds that birds have evolved to produce depending on the environment in which they produce the sound.) However, we must also acknowledge that emerging, ubiquitous computing technology is already altering performance environments in significant ways.

Second, I am proposing that a technology designed for use by audiences in a performance context should compliment the "flow" of the action in the performance—should induce audiences to become cognitively immersed within this flow. There are, however, alternate theories of audience engagement. Brecht's *verfremdungseffekt*, for example, was intended to keep an audience from becoming emotionally and imaginatively immersed in the action on stage, with the goal that sustained objectivity in the audience would create an increasingly critical audience capable of taking their critical eye to the streets. Plato's critique of mimetic arts also frequently surfaces as an early caution against the dangers of allowing audiences to become immersed in artistic mimetic representation. While I do hold philosophical/aesthetic opinions on the matter that will become apparent through the course of this dissertation, I do not want to engage in a prolonged defense of

my position on distinctly aesthetic lines. Brechtians may be pacified by the argument that there is nothing (to my knowledge) in the design process I am advocating that could not be used for their own ends. It should be possible to design an intentional flow that creates conceptual dissonance in a performance with the goal of engendering critical contemplation. However, the Platonic objection introduces a metaphysical argument about the mind's relation to an external reality, an objection that lies much more at loggerheads theoretically with my arguments. I wish to discuss the Aristotlian vs. Platonic conceptions of mimesis and the centrality of action in Aristotle's *Poetics* in Chapter 2. But as a preliminary introduction to this discussion, I might offer two reasons for my argument in favor of immersing audiences within a performance. First, according to philosopher Stephen Halliwell, Plato's objection to mimetic art forms arose out of both ethical as well as metaphysical concerns. His recognition of the power held by poets to shape a polis by directing their imagination and habituating them to the choices of dramatic characters led him to caution against poetic practices that habituate audiences toward vicious action.[42] He acknowledged the value of poetry that habituated an audience to virtuous actions while maintaining the metaphysical caveat that it nonetheless falls short of the propositionally reasoned examination of the forms provided by philosophy.

Second and most importantly, we cannot overlook the very practical consideration that technological development has led to the expectation by audiences that new technologies or new uses of existing technologies will be interactive. The idea of "web 2.0" is that the Internet now facilitates interactivity whereas in its original form, it merely disseminated (predominantly propositional) information. The practicality of this consideration is two-dimensional. Not only will

[42] Stephen Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems* (Princeton, N.J.: Princeton University Press, 2002), 52-54.

audiences expect interactive experiences, those interactions are embodied: tap here, double-tap there, use this slider, shake the phone, scroll, pinch, adjust the sound, adjust the brightness, look at the screen, listen to the speaker, speak into the microphone, take a picture, etc. Because the technology currently disrupting performance spaces presents audiences with embodied, non-propositional, interactive potentials for action, we cannot avoid the fact that we have left the domain of strictly propositional contemplation. It may be possible to design those interactions so that they present propositional material that sparks rational contemplation of a performance, but the interactions themselves would undoubtedly need to compliment the performance environment. It would be odd and counter-productive to both Aristotelians and Platonists to construct interactions that fall out of sync with the interactions presented for contemplation in a performance. Rather than promoting reasoned contemplation of the forms, such interactions would only seem to create what we currently have when it comes to performance and technology in the audience: chaos.

A third caveat of this dissertation pertains to the somewhat nebulous distinction between technology used by audiences and technology designed for performer use. Audiences currently "use" stage lighting instruments to see. They "use" the acoustics of a performance venue to hear. They "use" theatrical rigging to imagine certain things about actors and characters on stage. Similarly, an audience technology designed to compliment the flows of intentionality within a live performance will undoubtedly allow for some level of flexible manipulation by performing artists (or performance crews) either directly or in response to audience actions. There is always an element of reflexivity between performers and audiences in live performance. Working within this continuum of interaction, this project seeks to theorize and construct a technology that increases potential for autonomous audience action rather than performer action. I believe that this choice

will help create technologies that respond to performance, as opposed to performances in response to technologies.

1.4 CHAPTER SUMMARIES

1.4.1 2.0 Intentional Action, Performance, and Technology

Chapter 2 will focus on providing the theoretical foundations for the design of ubiquitous computing for use by audiences in performance spaces. Earlier in this introduction, I gave a fairly detailed outline of the theoretical approach I plan to develop further in Chapter 2. Building off of Aristotle's claim that tragedy is the imitation of an action, I will first examine the nature of action from a philosophical perspective. Action Theory holds an extended and respected philosophical tradition. I have chosen to focus on two popular, but opposed philosophical approaches to the concept of intentional action. First, I will examine what has become known as the "Standard Theory" of action developed in the latter quarter of the last century by Donald Davidson. I then propose several philosophical objections to Davidson's theory and contextualize it within historical developments in cognitive science, demonstrating its affinities with representational theories of mind. I then turn to the theory of action proposed by Davidson's predecessor, Elizabeth Anscombe, which is rooted in an Aristotelian and medieval understanding of action. I argue that Anscombe both avoids some of the problems faced by Davidson and also compliments very closely more recent theories of embodied and extended cognition.

I believe that Anscombe's theory rightly identifies intentionality embedded in the structure of our interactions in the natural world. This discovery allows Anscombe to distinguish between

theoretical and practical knowledge as two "parallel" but incommensurable fields of knowledge. Human cognition frequently draws upon both of these forms of knowledge simultaneously, and this type of correlated simultaneity, also frequently displayed in other types of cognitive function, forms the metaphor that I want to use to argue that audiences form an understanding of the various flows of intentionality found in a performance. These intentional flows are the articulations of intention in perception, emotion, and conceptual/propositional expressions. In effect, the artistry of performance artists and designers lies in their selection, intersection, and intertwining of multiple flows of intentionality. Correspondingly, an audience becomes "caught in the flow" of a performance as they comprehend these various flows of intentionality through each diverse articulation, each of which is identified through diverse and incommensurable but complimentary forms of knowledge. As philosopher Timothy Chappell argues, spectators (*theôros* in Greek) engage in more effective *theôria* (or "contemplation") to the extent that they display intellectual virtues such as open-mindedness, humility, and conscientiousness in their attempt to extract the object of their contemplation from these diverse but complimentary forms of knowledge.[43]

1.4.2 3.0 Experiencing Intentional Flows: Jazz as Proto-Interaction Design

The action analysis in Chapter 2 reveals a teleological structure of intentionality that underdetermines the meaning of any given act. Actions are therefore considered to be non-expressive. Propositional expressions of intentions do convey an agent's meaning or purpose for performing an action, but these expressions of intent are distinctly something other than the intentional action itself—they involve theoretical rather than practical knowledge. However, this

[43] Chappell, "Varieties of Knowledge in Plato and Aristotle," 186–189.

analysis appears to present two potential problems for my project. First, performing artists often insist that their performance actions do in fact mean something. Secondly, the teleological structure of intention that I have defended would seem to push my action analysis of performance in the direction of strong structuralism.

The first part of Chapter 3 sets about resolving these dilemmas by accounting for the fact that while the intentionality of action may evince a strong structure of relations between means and ends of action, audiences and musicians have the unique challenge of *experiencing* those actions. Experiencing contextualizes the performance act within a broad ecology that includes the physical time and space of the performance event as well as the culture in which it occurs and the particular history of the performance art form itself. Drawing on work in phenomenological musicology, I argue against both a structuralist and a purely functionalist reading of performance as action. *Experiencing* the intentional flows of performance is neither a process of "reading" a structural language within the performance, nor is it a product of high-level social function. Rather, experiencing music is itself an intentional, active process that involves a highly complex reciprocal feedback loop of action, sensory experience and expansive description of that experience.

In the second part of the chapter, I examine the phenomenology of jazz performance and argue that jazz by design provides musicians with parameters of performance that are inherently social and that guide performance choices and experiences while simultaneously underdetermining those performance choices. It is this design of underdetermined actions within parameters that makes jazz uniquely interactive and improvisational and makes it proto-interaction design. Consequently, it is possible and indeed desirable to use the intentional flows in jazz in the design of the Nymbus platform. However, a final theoretical step is needed to "slack the threads" of

intentionality in jazz performance in order to make the translation into a new technology. I offer that final theoretical component in Chapter 4.

1.4.3 4.0 Passive-Dynamic Interaction Design and Nymbus

Jazz as proto-interaction design does us very little good unless we can arrive at a means to transfer its design of interactivity into a new technological medium. There is a two-fold problem with identifying intentional flows in one medium and then "translating" them into another medium. First, intentional flows have been shown to display a teleological hierarchy. At what level(s) of this hierarchy should we translate the design? Second, even if we identify the correct levels of intentional granularity, we are "translating" those intentional flows into a new medium and when we do so, a new structure of action and interaction emerges, which entails an emergent art form. If we knew what that art form would emerge, the end of our translation, then the translation would merely be an issue of practical know-how. However, emergent ends are by definition unknown; we attain them by luck and, hopefully, prudence. I propose two solutions in answer to these significant challenges.

First, important work in the cognition of musical structure and meaning provides useful tools for identifying crucial hierarchies with our experience of musical intentional flows. Second, while the end of an act or series of actions may not be entirely known until it is achieved, we *can* arrive at a fairly good guess about what it will be by examining the actions that comprise it, but in the case of jazz, the actions that comprise it are highly complex. If we are going to base the design of interactions in a new technology on the actions that comprise a musical art form, then we need a method for making sense of the massive manifold of intentional actions of which the art is comprised. In this chapter, I argue that Aristotle's four causes provide the method that we need to

both parse the manifold of jazz intentionality and subsequently translate those intentions into a new medium. Aristotle's material, efficient and formal causes all provide their unique answers to the "Why?" of jazz actions. Furthermore, the principal of ecological balance in passive-dynamic design illustrates why these four causes operate together, which provides the final step of my theoretical argument, enables me to turn the intentional manifold of jazz into passive-dynamic interaction design, and apply it to the design of the Nymbus platform. I provide an extended discussion of Nymbus and its design in terms of my theoretical argument in the remainder of the fourth chapter.

I have directed a team of developers, designers and business professionals in the design and construction of Nymbus. Briefly stated, this platform gives musicians and lighting designers a creative pallet to interactively engage audiences at live music concerts using the audience's smartphones. As mentioned above, Nymbus is particularly designed for use in jazz performances as well as popular music. Given the liveliness of audiences of pop, rock, EDM concerts and the like, and the frequent use of smartphones by audiences in those environments, Nymbus works in those environments as well. However, it is also flexible enough to become useful in performance environments across the performing arts. The platform focuses on visual and aural effects designed to draw audience attention away from the phone screen itself and to contextualize the phone within the immersive, concert environment. Additionally, visual and aural effects may be programmed to respond to audience actions as they are sensed and measured by the phone's accelerometer and gyroscope.

To conclude this introduction, one might wish to devise an empirical test of whether or not the Nymbus system actually accomplishes my theoretical goals of aligning the intentional flows of the technology with the intentional flows in live performance. More precisely, one might wish

to determine whether or not audiences themselves find a "match" in these two intentional flows. Do audiences use the technology according to its design, and does that use help them attend to and comprehend the intentional action that is a live performance? One would hope that by using Nymbus, audiences will better attend to and comprehend a music performance than they do when occupied with other habitual uses of technology (texting, twitter, facebook, etc.).

Of course, this type of empirical verification is virtually impossible. Audience members seldom think in terms of the "intentionality of a performance" or the intentionality of mobile device use. Reflective, analytical response to a musical performance and response to use of phones in that performance entails a host of immediate cognitive (including emotional) processes as well as reflective considerations of the event. Studying that response must take into account socio-economic status, technology use, and psychological factors of individuals as well as group dynamics of the whole audience. Integral to these factors, the "history" or "relationship" that audience members have with the performer will also influence their reception of a new technology in the performance space. The quantity and diversity of these factors creates a great deal of "noise" in any survey data, rendering it ineffective to prove or disprove my hypothesis. Or so the argument goes.

However, I do not believe that these roadblocks to empirical verification are entirely valid. I have, after all, made a theoretical argument that locates meaning precisely in the tight interlocking of the empirical stuff of behavior with the psychological complexities of expanded descriptions. I imagine that employing the experience-sampling method of research into subjective experiences could take us a great way toward empirical verification. Nonetheless, I would also depend upon the theoretical argument of this dissertation to assert that when it comes to our collective, technological future, we are dealing in the realm of teleology—both technical and human—and

teleology is conceptually highly complex. New technologies are *new*. They introduce us to emergent states of being that are not quite commensurable with what we have experienced heretofore. Whether or not an existing teleology has been extended or a new teleology has been lain transvers to it is a matter of philosophical inquiry. In parsing flows of intentionality, empirical findings are highly useful, but ultimately whom we have been, the art we have learned, what we have made and where we are headed is a subject where measured contemplation must outstrip measured particles.

2.0 INTENTIONAL ACTION, PERFORMANCE, AND TECHNOLOGY

2.1 MIMESIS OF AN ACTION: ARISTOTLE'S INTENTIONALISTIC MIMETICISM

In Book VI of the *Poetics*, Aristotle defines tragedy as "…a representation of an action of a superior kind—grand, and complete in itself—presented in embellished language, in distinct forms in different parts, performed by actors rather than told by a narrator, effecting, through pity and fear, the purification of such emotions."[44] Lying at the core of his sole treatise on aesthetics, this definition has undergone centuries of commentary and influenced the development of entire schools of mimeticist aesthetic thought. It has become an important basis for dramatic and acting theory and remains highly influential today.

The second half of Aristotle's definition of tragedy qualifies the type of action, and subsequently in the Poetics, he further expounds what constitutes a grand and complete action, the type of language used, the plot structure, and other components that comprise tragic action. Within theatre and performance studies, we frequently use Aristotle's analysis of these components of tragedy. However, both within his central definition quoted above and in the structure of the *Poetics* as a whole, these aspects of his analysis are secondary. They modify his central focus on the action of tragedy and illustrate what makes that action "of a superior kind." They become important to Aristotle's aesthetic program by virtue of their relation to the primary concept of action at work in his ontological claim that tragedy is the "mimesis of an action." In this section, I

[44] Aristotle, *Poetics*, trans. Anthony Kenny, Oxford World's Classics (Oxford: Oxford University Press, 2013), 1449b.24–27.

will argue for the primary position of action in Aristotelian mimetic aesthetics. The mimetic function is best understood as the embedding of intentionality within physical media, which provides an important context to properly comprehending Aristotle's analysis of plot, character, *catharsis,* and the like in the later books of the *Poetics*.

Many of the concerns in the latter books of the *Poetics* still influence current critical theory and debate. Others are too often rejected for their role in failed aesthetic endeavors such as the late Italian Renaissance and French Neo-classical over-emphasis on the unity of action, time, and place. However, many of these debates would be greatly aided when placed in the context of an analysis of the Aristotelian conception of action. Debates concerning the meaning of *catharsis*, for example, could be informed by the relations between action, cognition, and emotion within Aristotle's extant body of work.[45] While it is entirely beyond the scope of this dissertation to closely examine how an Aristotelian conception of action and cognition could inform the purgation, purification, or intellectual clarification schools of thought on *catharsis*, what follows may prove helpful in that discussion, and may also further refine our understanding of what I have been referring to as secondary aspects in Aristotle's analysis—plot, character, idea, etc. These secondary aspects qualify and describe the essential medium of tragedy, namely, action.

If Aristotle's analysis of the components of tragedy fall on one side of the central idea that tragedy is a particular kind of action and illustrates what counts as an action "of a superior kind," we face no less of a challenge on the other side of that central idea. He states that tragedy is the

[45] Valuable work on the "intellectual clarification" model of catharsis has been carried out by Leon Golden, Steven Halliwell, and Donald Keesey among others. However, this work could, I think, be extended and a fuller appreciation of the complexity of the term within Aristotle's work could be derived from current work on cognition and action theory. Leon Golden, *Aristotle on Tragic and Comic Mimesis*, vol. no. 29, Book, Whole (Atlanta, Ga: Scholars Press, 1992); Stephen Halliwell and Aristotle, *Aristotle's Poetics* (London: Duckworth, 1986).; Donald Keesey, "On Some Recent Interpretations of Catharsis," *The Classical World* 72, no. 4 (1978): 193–205.

"…*representation* of an action…." Of course, "representation" is one translation among many of the original Greek "*mimesis,*" and as with *catharsis,* the debate over the proper translation and meaning of mimesis has become voluminous.[46] The difficulty lies in the complexity of the mimetic function. It posits a relation of similarity between two relata: the media shaped into an artwork and the object of representation. But the similarity of representation is characterized by something other than mere isomorphic, one-to-one correlation of physical properties—as a mirror reflects a physical object or as dancers often perform the same physical movements. Despite the unfortunate connotation in the translation of mimesis as "imitation," mimesis does not arise out of the visual, tactual, or aural semblance of the media of creation to the object of mimesis. The mimetic relation can exist on multiple levels between seemingly disparate objects and media. We identify it in a single media representing disparate objects and in differing media representing the same object.[47] Something more complex than a mere copying or "mirroring of nature" is at work in the mimetic function.[48]

Artistic media are, perhaps, somewhat easy to identify: the paint, clay, rock, musical notes, or in the case of tragedy, the actions that artists "shape" into the created work. However, the object or meaning of mimetic representation is not so easily identified. A portrait may represent a known

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[46] "*Mimesis*" is itself a transliteration. I follow Steven Halliwell, Anthony Kenny and others in the use of "representation" to translate this complex concept. Additionally, this translation need not commit us to a representation theory of mind. In fact, in what follows I wish to argue that Aristotle's account of the mimetic function seems more consonant with some form of embodied cognition. That art can represent something in the actual or an imagined world is difficult to deny, and I think that this type of representation is more properly construed as a "second-order" representation. The mental construct must already be in place for it to be artistically represented. To attribute a representational theory of mind to Aristotle based on his theory of *mimesis* would be to misappropriate a theory of artistic representation.

[47] Aristotle also observes that the same media may represent the same object, but in a different mode. He provides the example of narrative vs. dramatic representations at *Poetics,* 1448a19. Difference of mode need not figure prominently in this discussion of mimesis.

[48] Stephen Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems* (Princeton, N.J.: Princeton University Press, 2002), 172. states, "The idea of mimetic mirroring dissatisfied Aristotle, and this fits with his general avoidance of a conception of mimesis as a counterfeiting of the real."

person, but Aristotle recognizes an important alteration that artists bring to these representations. The artist may "improve" upon the subject. He states that, "…poets should copy good portrait-painters, who portray a person's features and offer a good likeness but nonetheless make him look handsomer than he is."[49] This type of artistic modification introduces the idea that the object of artistic representation exists somewhere other than solely in the object represented.

If embellishing upon real-world objects introduces a degree of differentiation of the represented artistic object from the artistic object existing in the actual world, artists may step even further away from a reality exterior to the artist by creating entirely fictional, alternate realities. The object of representation in these cases has no ostensible correlate in the actual world, which brings us to the substance of these observations regarding the relation of an artistic work to its object of representation: works of art are *not* mimetic by virtue of their correspondence to a reality that exists outside of the mind of the artist. If for the sake of argument, we translated mimesis as "imitation," we would be wrong to argue that a mimetic work of art imitates nature in terms of isomorphic, one-to-one perceptually indexed correlates. Mimesis happens at the level of mind. Undoubtedly this is mind in a material world, and that relation to the material world will become increasingly important in what follows, but given the history of mimetic thought, it is crucial to see that the mimetic function is a mental function rather than an "imitation of nature." As Halliwell argues, art only imitates nature in Aristotle's aesthetic theory by virtue of the way in which it instantiates form in matter and in the ordered pursuit of an end.[50] In order to understand this mimetic instantiation of form in matter we must know what serves as the object of representation as it is conceptualized in the mind of the artist and what the artist does to represent that object.

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[49] Aristotle, *Poetics*, 1454b9–11.
[50] Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems*, 153.

According to Halliwell, Aristotle's use of the fictional status of art works is a key differentiation from Plato's critique of the arts. Instead of following Plato's ontological formulation of art as a representation of the actual world, and hence twice removed from the forms, Aristotle relies on the idea that the artist creates a fiction, a "possible world" that becomes the object of representation. However, if these possible worlds are fictional and hence removed from the actual world, through the artistic, creative process, they are "embedded" in some way in the physical media of the actual world, which introduces the difficult question of how that embedding process takes place.[51]

As indicated above, we cannot understand that embedding solely by examining the physical media because a variety of differing media can represent the same possible world in a variety of differing ways. Halliwell observes that,

> The match between a mimetic art form and the features of the possible worlds that it represents involves, so *Politics* 8.5 suggests, a dimension of close correspondence but not necessarily at the level of the art form's physical media. In painting or sculpture, colors and shapes are used to represent the colors and shapes of imaginable objects; but in the case of music it is tones and rhythms that represent or express the emotions, feelings, or qualities of ethos that are 'movements of the soul.'

Similarly, a tragedian uses characters and actions, which are of great consequence, but only because the artist *does* something with them by shaping them into a plot that displays probability

[51] Current philosophical work in possible worlds (including work by literary theorists) could be helpful here, but I would like to choose a different tack. The issue at hand has to do with the fundamental question of how things in the actual world can have any meaning at all, which is a question frequently posed in philosophy of mind and cognitive science. Possible world semantics are helpful in outlining the logical structure of relationships between actual and possible worlds. This is very high-level conceptual analysis, but Halliwell insists that there is an essentially enactive function in Aristotelian mimesis. I would like to explicate this enactivity in much less abstract, more practical terms. As stated above, the processes whereby possible worlds are generated and enacted materially and culturally in the creation of artistic artifacts enables us to define the mimetic function in terms of intentional action. Saul Kripke, David Lewis, Robert Stalnaker, and Alvin Plantinga are some prominent philosophers of possible worlds. For work in literary studies and possible worlds see, Thomas G. Pavel, *Fictional Worlds* (Harvard University Press, 1986).; Doležel, Lubomír. Possible Worlds of Fiction and History: The Postmodern Stage. Baltimore: Johns Hopkins University Press, 2010.; and Marie-Laure Ryan, *Avatars of Story*, vol. 17, Electronic Meditations (University of Minnesota Press, 2006), http://www.upress.umn.edu/book-division/books/avatars-of-story.

or necessity in the actions of the characters in the dramatic work.[52] This shaping by the artist is the embedding of a possible world in those media.

Mimesis is difficult to articulate conceptually because it characterizes the relation between materials shaped by artistic activity and the possible world of ideas created in the mind of the artist. Aristotelian mimesis is, according to Halliwell, a dual-aspect theory of mimesis. The mimetic function turns on this correlation between a possible world and the physical stuff of a medium "shaped" by the artist into an artifact.[53] Halliwell argues that Aristotle keeps, "…the artifact and its meanings, the 'materials' and the 'object' of mimesis, conjointly in focus...Among the major features of the *Poetics* that display this dual-aspect mimeticism is the explication of formal unity as a property inseparable from the substance, scale, and internal relations of a poem (form inheres in the poet's organization of his materials) and yet also an aspect of the imagined human action of the work."[54]

Mimesis does not work solely at the level of the actual world, in the media of creation. Nor does it work solely at the level of an abstract possible world, by creating a fiction, complete and autonomous from any exterior reality. Rather, mimesis occurs in the *conveyance* of an abstract possible world in its relation to the actual world through diverse media, whether dramatic text, musical notes, paint, clay, or the movements and utterances of performers on a stage. As Halliwell

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[52] cf. Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems*, 195. "The universals of [*Poetics*] chapters 9 and 17 are built into the plot structure of a dramatic poem, into the causal network of actions and events that it comprises. As such, they also necessarily concern the agents, and chapter 9 makes this explicit: ''universal' means the sorts of things that it fits a certain sort of person to say or do according to probability or necessity.' So universals are not inherent in the raw stuff—the particular agents and actions—of a tragedy or comedy, not, at any rate, in a way, or to an extent, that differentiates these particulars from those of real life or of history. Poetic universals are embodied and discernible only in and through the organized mimetic structure of "action(s) and life" that the poet makes: this causally and intelligibly unified design of the artwork differentiates poetry, as Aristotle insists in chapters 8 and 23 as well as in chapter 9, from (many) ordinary events and hence from (much) history."

[53] Artifacts here being that which the artist creates and is capable of direct apprehension by others—whether semi-permanent sculpture or ephemeral performance.

[54] Ibid., 172–3.

observes, "Aristotle speaks of mimesis both as a property of works and performances of art and as the product of artistic intentionality; the subject of the verb *mimeisthai* can be an individual work, a genre, an artist (the primary "maker"), or a performer (the executant) of an artwork."[55] However, if an individual work or genre is mimetic, it is only so in the sense that it conveys a fictional world, which is a product of the mimetic action of the poet. As philosopher Aryeh Kosman states, "The fact that poetry is imitation does not mean that poetry imitates, but that it, like all literary discourse, is the internal object of an act of imitating."[56] Mimesis is not something that just happens to an odd collection of words or physical material; rather, it must be *made*. Mimesis can only become a property of works and performances of art through the intentional actions of the artist. Consequently, we must understand the particular way in which an artist acts in order to understand how a work becomes mimetic. Arguably, intentionality is conceptually prior to mimesis and it is possible to provide an intentional theory of mimesis.[57]

Forming this intentional theory of mimesis will occur in two steps. I would first like to examine the actions of artists as Aristotle conceives of them. This examination will prove helpful, but only insofar as it reveals an interesting structure in the process of artistic creation. The actions of the artist are ultimately a question of how the mind relates to the external world, what in some circles has come to be known as the relation between *intensional* mental phenomena and an *extensional* world.[58] Mimesis therefore naturally opens up questions of mind, and we may see that

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[55] Ibid., 153.

[56] Aryeh Kosman, "Acting: Drama as the Mimesis of Praxis," in *Essays on Aristotle's Poetics*, ed. Amélie Rorty (Princeton, N.J: Princeton University Press, 1992), 57.

[57] One could argue that all art forms require the intentional action of an artist. This might be thought to reveal a problem with an intentionalist conception of mimesis because Plato distinguishes mimesis from diegesis, the former being an embodied representation while the latter is a showing or reporting. Not all art forms are mimetic, according to this distinction. However, Aryeh Kosman argues that Aristotle made diegesis a mode of mimetic poiesis, and furthermore if artistic intentionality is a genius, it is probable that mimetic and diegetic works are species of it. See Ibid., 53–53.

[58] It will become increasingly clear that I do not hold to a strong intensional/extensional divide.

like intentionality in other spheres of human action, the crux and difficulty of Aristotelian mimeticism lies in identifying and characterizing the relation of human thought to a mind-independent reality.[59] This will comprise the second question explored in this chapter.

2.1.1 The Aristotelian Systematic Structure: Ends and Goods

Aristotle opens the *Nicomachean Ethics*, with the argument that every form of craft (*techne*) has some object.[60] All acts, decisions, crafts and lines of inquiry are done for the sake of some good.[61] This is not a claim for a single good over all other goods, it merely states that some type of good is always sought. Further, Aristotle argues that of the actions that seek a good, some are done for their own sake, while others are done for the sake of superordinate goods.[62] Yet, this does not mean that those actions that seek their own good cannot also seek the good of something else.[63] Just as playing an instrument can be a good in itself, it can also serve as the good of something else, namely the playing of an orchestral score.

Next, Aristotle asks, since all actions are done for the sake of a good, what is the highest good they seek?[64] His argument proceeds as follows:

(1) We cannot choose everything for the sake of something else because this would go on indefinitely.

(2) Desire does not go on indefinitely, but has a satisfactory end.

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[59] Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems*, 65.

[60] Terence Irwin, "Notes and Glossary," in *Nicomachean Ethics*, by Aristotle (Indianapolis, Ind.: Hackett Pub. Co., 1999), 1094a1–3.

[61] Aristotle, *Nicomachean Ethics*, trans. Terence Irwin (Indianapolis, Ind.: Hackett Pub. Co., 1999), 1094a1–4.

[62] Ibid., 1094a4–7; Irwin, "Notes and Glossary," 172.

[63] Aristotle, *Nicomachean Ethics*, 1096b16–20.

[64] Ibid., 1094a18–23.

(3) Therefore we cannot choose everything for the sake of something else.

(4) So, something must be chosen for its own sake.

(5) This something is the best good.[65]

It would be a mistake to think that this argument by itself implies that there is a single "best Good." There could very well be many goods that serve as the end points for numerous lines of action, decision etc. There are, in fact, numerous, differing goods according to the action pursued. Medicine pursues the good of health, generalship pursues the good of victory, house-building, the good of a house.[66] But some goods are chosen for their own sake and for the sake of some other end. Any end chosen for its own sake is complete, but it is more complete if it is chosen for its own sake without also being chosen for the sake of another end. Thus, the most complete end will be that which is chosen for its own sake, and never for the sake of some other end.[67] If one end is perfectly complete, then this end must be the best Good.[68]

Happiness or human flourishing, Aristotle argues, seems to attain this perfect, unqualified completeness. There are other goods that we would choose for their own sake even if they had no further result, goods such as honor and pleasure. Yet, all of these goods are also chosen for the sake of happiness.[69] This conception of happiness and the best Good is primarily theoretical at this point in his argument. The first step toward the more practical application of this theory begins with an understanding of the relationship between virtue, function, and goodness.

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[65] Irwin, "Notes and Glossary," 173.
[66] Aristotle, *Nicomachean Ethics*, 1097a15–24.
[67] Ibid., 1097a31–36.cf. "Complete" in Irwin, "Notes and Glossary," 320.
[68] Aristotle, *Nicomachean Ethics*, 1097a26–30.
[69] Ibid., 1097b1–6. Naturally, there is much more for discovery and debate concerning Aristotle's conception of happiness. The inclusive, exclusive debate and the extent of happiness in regard happy family and friends over time to name two such issues. A topic for another time….

According to Aristotle, achieving the good of anything pertains to the function of that thing.[70] That is, the thing cannot attain its good without performing its function well. The function of a knife is to cut; the good of the knife is cutting well—the fulfillment of its function. The function of a harpist is to play the harp; hence, playing the harp well is the good of the harpist. This fulfillment of the function is not merely a skill. The skill involved in playing the harp well may be considered a virtue of the harpist—what allows her to attain her good. A harpist who lacks this virtue may fulfill her function as a harpist, but not well. She lacks the virtue that accords with her function, and to the degree that she lacks it, she will not attain her good.

Performers are artists. We often think of an artist as one who makes something to be displayed or enjoyed for its own sake. But it is easy to assume a distinctly Romantic understanding of how something might be enjoyed for its own sake. In the history of aesthetics this often takes the form of art for art's sake and the cultivation of the disinterested artist. Etymologically, "art" is derived from the very practical idea of "craft" or technical ability, and only in the 17th century did it begin to take on a distinctly imaginative, creative connotation that holds no immediately visible, instrumental purpose.[71] While Aristotelian mimetic thought includes the possibility that the good of performance may be in a qualified way pursued as an end in itself, the Romantic aesthetic is a position entirely foreign to Aristotle specifically as well as to ancient aesthetic thought in general. Halliwell observes that, "The mimetic arts are certainly counted by Aristotle as belonging to the class of *techne* (craft, artistry) as a whole, and, more particularly, as forming a subdivision of *poiesis* (making) or productive craft."[72] The simplicity of this categorization conceals a complexity

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[70] For this argument, see Ibid., 1097b22–1098a21.

[71] "Art, n.1 : Oxford English Dictionary," *OED Online* (Oxford University Press, June 2014), http://www.oed.com.pitt.idm.oclc.org/view/Entry/11125?rskey=Ge1HOx&result=1#eid.

[72] Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems*, 153.

of thought about the poetic arts that draws deeply from Aristotle's conception of human action and goods broadly conceived.

Ontologically, Aristotle contrasts *poiesis* or production, which is the domain of non-natural, made things (of which poetry is an example), with *physis*, the domain of natural things. The chief difference between the two lies in their principals of existence, or that which orders something's coming to be and continued growth and development.[73] The principal of existence in *physis* is within the thing that exists, while the principal of non-natural things in the domain of *poiesis* lies within their creator. As poiesis is the domain of things that are made, the *Poetics* presents a theory of the particular activity of poetic *production* or *making*.[74] Poets and performance artists broadly considered make things. The type of rationality that they use and the structure of their actions resemble other forms of making in a very fundamental way.

2.1.2 Mental and Mind-independent Realities in the Structure of Ends

In Book VI of the *Ethics*, Aristotle examines the role of reason in human action, identifying five virtues of thought or types of reasons that allow thought to fulfill its function in a given situation. In order to understand the virtues or capacities of thought that enable us to reason well, we must understand the things about which we reason. Aristotle identifies two broad categories of rationality: necessary truths of reason, such as the truths of mathematics, and contingent truths, such as the size and shape of the earth or the climactic plot structure of a tragedy. Both of these

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[73] See the *Physics* Book II, Chapter 1. The following discussion of the Aristotle's taxonomy and nomenclature of action the virtues of thought are highly indebted to Irwin, "Notes and Glossary."; Glenn, E., "Mimesis," ed. Edward Craig, *Routledge Encyclopedia of Philosophy*, Book, Whole (New York; London: Routledge, 2000); and Maarten Franssen, Gert-Jan Lokhorst, and Ibo van de Poel, "Philosophy of Technology," ed. Edward N. Zalta, *The Stanford Encyclopedia of Philosophy*, 2010, http://plato.stanford.edu/archives/spr2010/entriesechnology/.

[74] cf. Glenn, E., 2000.

classes of thought have distinct virtues of reason. We come to know necessary truths through our capacity for *episteme* or "scientific knowledge," which operates through deductive inference.[75] Contingent facts, or "what admits of being otherwise," Aristotle states, "…is achieved in action and production." The two primary virtues of thought that achieve action and production discussed are *phronesis* and *techne*, or prudence and craft knowledge respectively.

Techne is the capacity to reason about production. House building, shipbuilding, and medicine are the classic examples that Aristotle gives of techne.[76] In all of these activities, the principal of production, or that which ensures its continuance and completion, lies within the person engaged in that form of reasoning. A house will not build itself, nor will a ship, and while bodies may sometimes heal themselves, it takes the continued efforts of medical professionals to see the medical arts through to completion. All of these instances of techne would seem to involve extensive human action. However, in Book VI of the *Ethics* Aristotle explicitly contrasts techne with action, which he calls "prudence." He writes, "…prudence [*phronesis*] is a state grasping the truth, involving reason, concerned with action about things that are good or bad for a human being."[77] We tend to think that medicine is concerned with action about things that are good or bad for human beings, but the distinctive quality of prudential action that Aristotle identifies is based on a key distinction in the end that the various virtues of reason seek.

Techne seeks an end outside of itself. The end of shipbuilding is a ship. The end of house building is a house. The end of medicine is health. Prudence, on the other hand, seeks an action

[75] Because Aristotle limits episteme to necessary truths discoverable by deduction, he precludes a practical science of contingent facts about the world from falling under this category of knowledge. The proofs of scientific episteme may be repeatable as our current scientific method demands, but their proof lies in logical necessity, not repeatability.

[76] Aristotle, *Nicomachean Ethics*, 1140a.

[77] Ibid., 1140b5–6.

that is an end in itself and furthermore the final end in itself. While other virtues of thought may also seek ends in themselves, the end of prudence is the ultimate end of all human action, which is happiness or human flourishing. Aristotle states, "It seems proper to a prudent person to be able to deliberate finely about things that are good and beneficial for himself, not about some restricted area—about what sorts of things promote health or strength, for instance—but about what sorts of things promote living well in general."[78] This distinction of phronesis and techne based upon the types of ends that they seek clarifies Aristotle's conception of human action in general.[79] It would seem odd to argue that the productive crafts, shipbuilding for example, are *not* human action. Furthermore, if Aristotle does not consider production to be human action, then my earlier insistence on the importance of intentional action in his account of mimesis is incorrect. However, rather than denying that production is in fact human action, Aristotle is merely identifying an important distinction within action and categorizing the virtues of reason according to that distinction.

In the corpus of his work, Aristotle uses several terms to delineate some of the conceptual complexity found in human action. Philosopher/translator Terence Irwin identifies three "levels" of meaning associated with the first of these terms, *praxis*, which is often translated "action."[80] First, it broadly includes all intentional actions that desire some end and are focused on a particular situation by a set of beliefs. In this sense, all animals, human and non-human, are capable of praxis. In the second level of meaning, Aristotle refines his definition of praxis to refer only to action that

[78] Ibid., 1140a26–29.
[79] Ibid., 1140b36.
[80] Irwin, "Notes and Glossary," 315.

is informed by a decision based on reasoned reflection.[81] Finally, he refines praxis further to refer to a type of decisive, rational action *that is its own end*; it is not done strictly for the sake of some further end beyond it. It is action as an intrinsic rather than an instrumental end. This final distinction, action that is its own end, distinguishes praxis from all forms of human poiesis, or production. While poiesis is indeed human action, it is not strictly speaking, action that is pursued as an end in itself.

This argument that poiesis is *not* a form of praxis rests on the difference of structure in their individual components. In any production, there is a sequence of events that go into bringing about that production. In house building, for example, individual bricks must be laid; individual boards must be cut and nailed together. This sequence of events is made up of "movements" (a frequent translation of *kinēsis* and *metabolē*) that go into bringing about the completion of that production. And the completion is important, because the completeness or incompleteness of the activity differentiates production from praxis. Production is comprised of incomplete activities, or activities that are progressing from a state in which their capacity for continuance, roughly, their *energeia* in Aristotelian thought, is in decline. To return to the example of house building, the placement of bricks and the nailing of boards comes to an end when the bricks and boards have been exhausted (assuming that there are enough to complete the house as it is envisioned by the builder/architect). Or to employ a more musical example, the playing of notes on a score is completed when the final note is played. Of course, the exhaustion of physical components is not as important as the fact that the individual "movements" required to exhaust those components are all *instrumental* toward the building of the house or the playing of the score. The house and the

[81] It is important to note that although Aristotle identifies deliberative desire as the "principal" of decision, this does not commit him to the popular "belief desire thesis" in current action theory, which states that a belief plus a desire is the *cause* of action. This thesis propounded by Donald Davidson will be examined later.

score are the end that lies beyond the individual actions that are performed to bring it about. By aiming for something beyond itself, a house or a performance, production will reach a point of conclusion after the movements of which it is composed have achieved their end. The house and performance will stand as witness to the activity of production, but they are not themselves productions properly considered, they are beyond it.

When we speak of artistic production as an "end in itself" we must distinguish between the actions of the artist and the artistic production. In Aristotle's taxonomy of action, the artistic actions that comprise production are importantly not ends in themselves. They are all carefully composed to bring through their composition a work that does not exist apart from their composition and that stands as witness to their exhaustion and completion. Praxis, on the other hand, does not suffer a decline in capacity as it is actualized. As Irwin observes, "Seeing or living, for instance, does not imply the loss of the capacity to see or live."[82] In this way, praxis is a more fully complete action than production may ever become. Because it is its own end, its exercise is its completion.

Aristotle holds that because techne seeks an end outside of itself, it is not *praxis*, at least in the third, most refined sense of the term described above. Praxis as it applies to all of life is the ordering of instrumental goods for the sake of achieving a chief good, or flourishing. Because human flourishing is the chief good, it is not only an end in itself, it is the ultimate end, and prudence is the virtue of reason that seeks this end. Techne, on the other hand seeks an end outside of itself, and this end is not the final end. The building of ships and writing of tragedies are *indeed* human actions, but they are not praxis, the ultimate end of a flourishing human life. Poetics is skill or craft in the human capacity for techne, not phronesis, but there is an important relationship between the two.

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[82] Ibid., 316. Irwin's very helpful glossary of terms has been helpful throughout this discussion.

Kosman observes that when Aristotle defines tragedy as the imitation of an action in Book VI of the *Poetics*, it is imitation that must take place over time.[83] Additionally, while the exact nature of Aristotle's conception of human flourishing is open to debate, he does require that it include the active exercise of capacities over time, not merely the attainment of a *state* of flourishing.[84] If some actions are instrumental in the accomplishment of further ends, but praxis under its most refined definition is the action of attaining one's chief end, we cannot attain that end without the pursuit of purely instrumental actions because praxis is at least in part the exercise of our instrumental capacities of thought and action. Rather than distancing dramatic performance and poetic composition from the realm of the action of praxis by identifying it as the "*mimesis* of an action (praxis)," Aristotle is revealing its key place within an overarching structure of human action in which individual acts of performance are intricately linked to one another in instrumental service of an end. That end, the performance, is an end in itself, but not a final end. Rather, it serves as a conception of a possible world, and in that capacity it is itself instrumental to the pursuit of the final, ultimate end of human flourishing.

These distinct types or classes of action are illustrated in Kosman's examination of the often observed stipulation that the mimesis of tragedy must be accomplished "*drōntōn kai ou di apangelias*," which Kosman translates "by means of acting and not by means of narration."[85] Kosman states,

> …the word of interest here is the word that gives rise to its being called dramatic in the first place, the word *drōnotōn*. This word is an inflected from of *dran*, which Aristotle has earlier reminded his readers is the Doric for *to act*, equivalent to Attic *prattein*. To describe

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[83] Kosman, "Acting: Drama as the Mimesis of Praxis," 57.

[84] See *EN*, 1095b32, 1178b18-20; Irwin, "Notes and Glossary," 316.

[85] Kosman, "Acting: Drama as the Mimesis of Praxis," 57. Kenny translates this phrase as "…performed by actors rather than told by a narrator" emphasizing the performance rather than the poetic mode. Of course, Aristotle's distinction under either translation gives rise to speculation regarding its relation to his often cited denial of the need for an actual performance of the dramatic work.

> a tragedy thus as *acted* is to make clear that the medium of the mimesis of an action is itself an action. But in using a term which is equivalent to but distinct from the standard Attic term for action Aristotle makes clear that it is an action of a special and peculiar character. It is an action which is an instance not of *prattein* or *praxis*, but of *dran* or *drasis*, and its internal product is therefor not a *pragma* or *praxis*; it is a drama. We may describe such action using a scholastic distinction as formally a drama and objectively a praxis, and this way of putting the difference reveals the logical tie [that] it is a drama because it is the mimesis of a *praxis*.[86]

What is at stake in this observation is the essential connection between technical and prudential knowledge, or instrumental action whose end is beyond itself (techne) and action that is an end in itself (phronesis) by virtue of its search for the good life. By linking the two together in his identification of tragedy as the imitation of an action, Aristotle proposes a highly robust conception of the action involved in poetic construction. The artistic work of poets and performers are not merely comprised of the individual actions of the characters (and actors) on stage, rather *by the very acts themselves* the makers of poetic works of art employ the rational virtue of phronesis and convey a vision of the good life by which the individual actions of the characters find their meaning. This is not to argue that the actions portrayed in performance convey those actions needed to attain human flourishing, one need look no further than Aristotle's own central example, *Oedipus Rex*, to find the contrary. But the meaning, emotional impact, and tragedy of *Oedipus* cannot be comprehended apart from some conception of what it means to flourish as a human. Philosopher Rüdiger Bittner sums up the point well,

> It may be suspected that the playwright and the moralist, using the same word "action," are nevertheless dealing with different things. It may be suspected, that is, that Aristotle's statements about actions in tragedies are irrelevant to actions in life. But the very fact that he is using the same word in the *Poetics* and in the *Ethics* makes this improbable; and freely referring to various tragedies in the *Ethics* he shows that he does not recognize

[86] Ibid., 57–58.

> a gap between the two genres: what tragedy represents and *Ethics* investigates is the same sort of thing. Indeed, tragedy would be irrelevant otherwise.[87]

These references to human flourishing as an important part of poetic creation can also extended into Aristotle's emphasis on the essential place of human society within the "good life." Not only is friendship an essential ingredient to human flourishing, the importance of civic organization and cultural traditions impacts the intentionality conveyed in a work of art. Halliwell argues that the mimetic status of works of art in part arise out of the communication between,

> …artists or "makers" (such as poets or painters), performers (such as actors or musicians), and audiences (whether individuals or groups such as theater audiences). This means that the "intentionality" of mimetic works is not located simply in the specific designs of the particular artist but also in the shared conventions, traditions, and possibilities of a culture. The mimetic status of certain art objects is a matter of their having a significant content that can and, if their mimetic status is to be effectively realized, must be recognized and understood by their audiences.[88]

Hence, the conceptual centrality of action within performance references the fact that all action takes place within a broad cultural context, which is also highly important to our functioning as complete persons. Because of its teleological relation to the final end of human flourishing through the intentional structure of individual actions, Aristotle's sense of poetic "making" is intimately connected to the emotional impact and psychological and ethical relevance of human action extending outside of the poetic domain. Artistic practice, rather than maintaining a position in the catalogue of human endeavor that is segregated in its purpose from "mundane" existence, is critically similar in its practical outcome and application to any other endeavor. Performance particularly, in its careful observance and arrangement of actions *as a medium* engages the artist

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[87] Bittner Rüdiger, "One Action," in Essays on Aristotle's Poetics, ed. Amélie Rorty (Princeton, N.J: Princeton University Press, 1992), 98.

[88] Halliwell, *The Aesthetics of Mimesis : Ancient Texts and Modern Problems*, 153.

as a fabricator of action and requires expertise in our capacity to convey multiple layers of meaning with efficiency and elegance.

At base, live performance is a series of actions, but the relation of these actions to one another and to the artist's conception of the final end of human flourishing elevates their very mundane status to lofty emotional, ethical and psychological heights. Regardless of their fictional status, the actions of mimetic poiesis have the goal-directed structure of all action, and consequently hold the capacity to habituate both performers and audiences to a particular way of seeing and responding to the world, thereby placing performance within the purview of classical virtue ethics in its assessment of the "success" or "failure" of agents in search of the good life.

Both Aristotle and Plato understood this. We often note Plato's condemnation of the mimetic arts as "twice removed" from the forms, but the heart of this critique lay in his respect for the artist's ability to convey a vision of life that through the actions of creation could habituate audiences to patterns of acting that failed to promote flourishing. Halliwell observes that Plato's later works convey "…a sense that the world itself is a mimetic creation, wrought by a divine artist who, at one point in the *Timaeus* (55c6), is expressly visualized as a painter. That being so, philosophers are not only, as the *Republic* would have it, painters in a different medium, or, as the *Laws* suggests, writers of the truest tragedy. They are also interpreters of a cosmic work of art."[89] This would seem to indicate that Plato identified the crucial role of action within human cognition and rationality broadly considered.

[89] Ibid., 71.

2.1.3 Preliminary Conclusions from Aristotle

We may derive a number of conclusions from this analysis of Aristotle's conception of the poetic arts. First, poetic creation in both composition and performance exhibits carefully structured relations between the actions that comprise it and employs differing virtues of reason in the ordering of those acts. The capacity of reason exercised in poetic creativity, namely techne, operates and discovers meaning in the specific relations between the individual acts that comprise the work. An important facet of these relations pertains to the common means-ends and part/whole relations between them. A house is the house that it is in large part by virtue of the individual steps that went into its creation. These steps are both instrumental toward the larger goal of the house and they incrementally comprise the house as a whole. A musical score is only the score that it is through the relation of the notes that comprise it, and because of this internal structure of the piece as a whole, no note is chosen at random even if the compositional process makes use of *techniques* that select or generate randomized sounds. Furthermore, the actions that comprise the piece happen over time. The rationality involved in action is not a state of mind, but rather is extended and unfolds over time.

Secondly, this structure of action is ordered teleologically. The parts are logically ordered toward an end. In other words, if a performance derives meaning from the relations between the actions that comprise it, it also derives meaning from the conception of the end that those human acts seek. This ordering of ends follows an expansion of circumstance as it moves up the means-end ordering of goals. The circumstances influencing the placement of a single note within a score are narrower than the circumstances influencing the composition of the score as a whole, and although they are closely interrelated, these differing scopes of circumstance are important to how we comprehend the intention of individual acts. Although reasoning about a final end is a function

of our capacity for phronesis, not techne, the two are interrelated and interdependent. Consequently, the meaning of poetic acts is always in reference to a broader conception and understanding of what it means to act in daily life.

Thirdly, human creations form a cultural ecosystem with and about which we interact. Consequently, the actions of a performance are comprised of bodies in motion within a natural environment *and also* within a cultural environment created by other humans. The "shared conventions, traditions, and possibilities of a culture" are part of what shape the knowledge and means-end conception of action that both the creators and audiences of performance art use to comprehend the meaning of performed actions. In regard to the actions of a performance, cultural constructs within a performance are in an important sense no different than the physical particulars around which performance actions are shaped. They may highly impact the structure and meaning of the actions portrayed, or they may, like the thymele of a deteriorated Greek stage, lie displaced, forgotten or unknown, and passed over.

However, fourthly, even when cultural constructs remain widely celebrated, Aristotle's view avoids cultural determinism, and explains how cultural norms are circumvented. The principal of the poetic creation—the common beliefs of a society as they are known by the artist—lies within the artist rather than being derived from the nature of the thing made. Hence, human creative action constantly introduces *emergent* structures of action and meaning as the individuality of the artist holds dialogue with broader cultural activity. Given this dynamic of human production relying on individual knowledge and belief, we might be more surprised by cultural constancy than cultural variation.

Fifthly, insofar as techne and poiesis are rational virtues concerned with actions, they deal in particulars because action deals in particulars. Because of this, these rational virtues rely on

perceptual experience in order to become aware of particulars—the ‘facts of the situation.' But notice here Aristotle's subtle and extremely close connection between reason and particulars despite his frequent placement of perception and non-rational desire in contrast to rational desire and decision.[90] Irwin notes that in addition to an exercise of the five senses, Aristotle uses the verb for perceive (*aisthanesthai*) to, “…indicate noticing or being aware of something (as in English ‘I see') without any very specific reference to the five senses.”[91] The ability to determine the difference between, for example, teasing and cruelty or a *beau geste* and an unwelcome intrusion often turns on both an awareness of particulars exercised by both ordinary perception and prudent attendance to the specifics of one's situation. Both are highly relevant to the intentionality of an act.[92] The relation between perception, desire, and action will feature more prominently in the following discussion of the philosophy of action.

2.2 DONALD DAVIDSON'S “STANDARD THEORY” OF HUMAN ACTION

Intentional action has an extensive conceptual history that has received a revival of interest in the last century. There are a number of ways to conceptualize intentionality, but modern philosophical perspectives often proceed by seeking an account of how explanations for an action are related to the action itself. Two dominant strands are particularly helpful in negotiating this discussion as it relates to cognitive science. One strand follows Donald Davidson's highly influential theory that draws a particular type of causal connection between beliefs and desires that an agent holds to the

[90] Irwin makes this observation at Irwin, “Notes and Glossary,” 341–342.. See also Aristotle, *Nicomachean Ethics*, 1095a4..

[91] Irwin, “Notes and Glossary,” 341–342.

[92] Aristotle, *Nicomachean Ethics*, 342.

action that he performed. As the theory goes, the beliefs and desires held by an agent rationalize an intentional action and are a form of *causal explanation* of that action. Davidson's view of "causal explanation" is quite nuanced, and it is important to differentiate this type of causation from the type of billiard ball causality pre-theoretic notions of event causation might lead us to envision. Beliefs and desires are *states* of an agent that become causal explanations only if they are associated with a causally efficacious event, like the event of acquiring a relevant belief or desire. For example, I may become restless and hold the belief that this restlessness arises when I have not had a stroll about the room in a while. I may also believe that if I stand up and walk around, then the restlessness will cease. If I subsequently experience the event of coming to desire that my restlessness should cease, then (barring considerations that would check this desire) this conjunction of beliefs and desires causally explain my intentional action of rising from my chair. Restlessness, holding a belief about the cause and relief of restlessness and the desire to end it are *states* in the agent, not events on Davidson's view.[93]

For Davidson, not every combination of beliefs and desires are considered causal explanations of intentional action. These mental states must hold a relation to action *in the right way* in order for it to be an intentional action. As Davidson states, "For a desire and a belief to explain an action in the right way, they must cause it in the right way, perhaps through a chain or process of reasoning that meets standards of rationality."[94] This account of action relies heavily

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[93] Frederick Stoutland provides a helpful explanation of Davidson's position: "Davidson…denied that beliefs and desires are causally related to actions on the ground that they are states rather than events. His view is that beliefs and desires figure in causal explanations, which do not connect events but sententially structured items—states, facts, situations—and are, therefore, sensitive to how reasons and actions are described. He held, moreover, that there is a conceptual connection between an agent's beliefs and desires and her acting intentionally, but he did not think that rules out a causal-explanatory connection." Frederick Stoutland, "Introduction," in *Essays on Anscombe's Intention*, ed. Anton Ford, Jennifer Hornsby, and Frederick Stoutland (Harvard University Press, 2011), 22, http://site.ebrary.com/lib/pitt/Doc?id=10488678.

[94] Donald Davidson, *Essays on Actions and Events* (Oxford: Clarendon, 2001), 232.

on the cognitive impact that beliefs and desires are thought to hold on an individual. The intentional content from which action is thought to arise, because of its inferential and rational structure, holds a striking similarity to the "language of thought" model of cognition that forms the backbone of good old-fashioned artificial intelligence and a representational theory of mind such as the one espoused by Jerry Fodor.[95] William E. Lyons argues in *Approaches to Intentionality*, this type of psychological explanation of intentionality is unlikely to yield the results that it sets out to yield. Lyons argues:

> Fodor has not given us a new special science of psychological explanation based on our folk psychological explanations in terms of beliefs, desires, and the other propositional attitudes. Rather he has given us a brain's-eye-view of the propositional attitudes. He has told us what he believes must be the case if propositional attitudes are really in the head. He has told us that we must have in our heads a representational system, which is more like a natural language than any other representational system.[96]

The language of thought model has consistently faltered in adequately incorporating the importance of perceptual and embodied contextual clues that provide information in the form of "causal impresses or imprints, like footprints, rather than by rule-governed expressions or representations or inscriptions, like sentences."[97]

Above I said that Davidson's view holds a *striking similarity* to Fodor's Language of Thought model of cognition, but similarity is not identity. Davidson sought to explain intentional *action* whereas Fodor was attempting an account of intentional *states*. While the two are related, they are not identical. Contrary to Fodor, Davidson did not think that intentional states such as beliefs and desires that hold propositional content subject to psychological explanation could be

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[95] William Bechtel, "Introduction," ed. William Bechtel, George Graham, and D. A. Balota, *Companion to Cognitive Science*, 1999, 65; William E. Lyons, *Approaches to Intentionality* (Oxford: Oxford University Press, 1995), 55.

[96] Ibid., 55.

[97] Ibid., 65.

reduced to scientific explanations provided by physics and chemistry.[98] Nonetheless, if perceptual and embodied context plays an important role in cognition not accounted for by Fodor's Language of Thought model, Davidson's causal explanatory theory of intentionality can be critiqued along similar lines.

Among the followers of Davidson's theory, there is disagreement over whether the causal chains leading to action begin with a belief or a desire, but it is generally conceded that a mental state of desire holds the correct relation to the world outside of the agent to motivate an action. This relation is conceived of as a particular "direction of fit" that beliefs and desires hold toward the world. Beliefs are thought to hold a "world-to-word" direction of fit due to our tendency to change our beliefs to match the state of the world. Desires, on the other hand, hold a "word-to-world" direction of fit due to the fact that if the state of the world conflicts with our desire, then we change the world. It would seem that this peculiar asymmetry of beliefs and desires does indicate that some sort of causal relation is in play. However, the nature of this causality has proven difficult to characterize. As Davidson argued, a general account of the way that attitudes cause actions *in the right way* may prove difficult or impossible to provide.[99]

Furthermore, Anscombe and later Vogler have argued that the difficulty for Davidson's theory runs deeper. It is possible for someone to hold propositional attitudes that logically point toward the execution of an action (or said more precisely, "are associated with an event causally efficacious of an action") that one *inadvertently* completes while still failing to act intentionally from a reason.[100] There are two particular types of cases that illustrate this critique. First, an agent

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[98] Davidson held the common position that the mental supervenes on the physical, thus simultaneously rejecting both reductive physicalism and dualism.

[99] Davidson, *Essays on Actions and Events*, 80–81; Candace Vogler, "Anscombe on Practical Inference," in *Varieties of Practical Reasoning*, ed. Elijah Millgram (MIT Press, 2001), 440.

[100] Ibid., 441.

may be in a psychological state that could causally explain a bodily movement, which is nonetheless the result of reflex, not an intentional action. Second, issues of double-effect, in which we must explain foreseen or unforeseen effects of our action, present problems for Davidson's account. Concerning the first problem, Davidson examines a counter-example of a mountain climber who holds the right propositional attitudes to adequately rationalize an action, but this rationalization still falls short of causal explanation. Davidson writes,

> A climber might want to rid himself of the weight and danger of holding another man on a rope, and he might know that by loosening his hold on the rope he could rid himself of the weight and danger. The belief and want might so unnerve him as to cause him to loosen his hold, and yet it might be the case that he never chose to loosen his hold, nor did he do it intentionally…Since there may be wayward causal chains, we cannot say that if attitudes that would rationalize *x* cause an agent to do *x*, then he does *x* intentionally.[101]

These "wayward causal chains" are precisely what Anscombe draws on to argue that the intentionality of an act is not derived from the psychological *history* of agents. Anscombe issued this direct critique of his climber counter-example and the solution he proposed to it,

> The psychological 'because', [Davidson] supposes, is an ordinary [causal] *because* where the *because* clause gives a psychological state. The solution lacks acumen. True, not only must I have a reason, it must also 'operate as my reason': that is, what I do must be done *in pursuit* of the end and *on grounds* of the belief. But not just any act of mine which is caused by my having a certain desire is done in pursuit of the object of my desire; not just any act caused by my having a belief is done on grounds of the belief. Davidson indeed realizes that even identity of description of act done with act specified in the belief, together with causality by belief and desire, isn't enough to guarantee the act's being done in pursuit of the end and on grounds of the belief. He speaks of the possibility of 'wrong' or 'freak' causal connexions. I say that any recognizable causal connexions would be 'wrong', and that he can do no more than postulate a 'right' causal connection in the happy security that none can be found. If a causal connexion were found we could always ask: 'But was the act done for the sake of the end and in view of the thing believed?'[102]

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[101] Davidson, *Essays on Actions and Events,* 79.

[102] G. E. M. Anscombe, "Practical Inference," in *Virtues and Reasons: Philippa Foot and Moral Theory: Essays in Honour of Philippa Foot*, ed. Rosalind Hursthouse, Gavin Lawrence, and Warren Quinn (Clarendon Press, 1998), 2. Davidson in fact never produced a "right causal connection."

The second problem for Davidson's theory pertains to the principal of double-effect. Our actions may have both foreseen and unforeseen effects that may or may not be intentional, but we must explain what makes these effects intentional or unintentional. By all accounts, Oedipus did not intend to kill his father and marry his mother. Or so it would seem: how do we in fact know that he did not set out from Corinth with such an intent but also the intent to forever conceal this objective? Before getting too deep into an agent's considered judgments about the potential outcome of an action, consider Davidson's variation of the Oedipus story:

> A man might have good reasons for killing his father, and he might do it, and yet the reasons not be his reasons in doing it…For suppose, contrary to the legend, that Oedipus, for some dark oedipal reason, was hurrying along the road intent on killing his father, and, finding a surly old man blocking his way, killed him so he could (as he thought) get on with the main job. Then not only did Oedipus want to kill his father, and actually kill him but his desire caused him to kill his father. Yet we could not say that in killing the old man he intentionally killed his father, nor that his reason in killing the old man was to kill his father.[103]

The example, Vogler points out, illustrates that the causal chain in the story is "wrong," thereby presenting a formidable defeater to the causal explanatory account of intentional action.[104] Paraphrasing Anscombe, Volger states, "…tight links between the contents of propositional attitudes and true descriptions of actions caused by those attitudes may *not* illuminate the character of intentional action and reasons for acting *at all*."[105] It is possible to devise a reasonable scenario in which propositional attitudes (the contents of beliefs, desires, memories, etc.) appear to *causally explain* events that are in fact *not* intentional actions. The problem lies in Davidson's insistence on explanatory causality, as Frederick Stoutland observes, "The distinction between action and mere movements is one any agent can make about herself, and while it may occasionally be difficult to apply to others, no theory about causation will help in applying it. The problem is an artifact of

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[103] Davidson, *Essays on Actions and Events,* 232.
[104] Vogler, "Anscombe on Practical Inference," 442.
[105] Ibid., 441.

Davidson's thesis about the role of causation, and it will cease to be a problem if the thesis is rejected."[106]

These arguments against Davidson in no way represent a comprehensive engagement with his work or the extensive body of literature surrounding it. Such a task would take me far afield of the purpose of this dissertation. I have merely tried to open the discussion of action by illustrating some of the difficulties of approaching intentionality from a purely psychological, causally explanatory point of view as well as contextualize the following discussion of Anscombe's work on action

2.3 ANSCOMBE: INTENTION IN THE STRUCTURE OF ACTION, PRACTICAL RATIONALITY, AND PRACTICAL KNOWLEDGE

Rejecting Davidson's belief-desire thesis and causal explanatory theory of intentionality appears theoretically expedient. However, within performance and theatre studies, we frequent analyze performance in terms of the choices of agents derived from their beliefs and desires or their analysis of another character's beliefs and desires. We ask what a character knows or believes about the “given circumstances” in which she acts. We often speak of a character's “objectives,” “motivations,” and “obstacles,” which are a cluster of concepts surrounding her desires and what she believes to be the case about the world. Furthermore, in common parlance, we explain actions as if they are caused by a set of beliefs and desires *within* the agent. Such folk psychological accounts of intentional action are difficult to think beyond.

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[106] Stoutland, “Introduction,” 25.

Accepting Anscombe and Vogler's critique of Davidson's account of action requires an alternate theory to identify and conceptualize intentional action as other than caused by a combination of beliefs and desires. Additionally, an alternate theory must distinguish intentional action from mere bodily movement or the unforeseen effects of actions. While we intuitively make this distinction daily, it is difficult to conceptually define. Yet, it would be a mistake to tacitly limit our subject of inquiry to intentional action without showing *how* it is intentional. This is, in fact, a central mistake that Anscombe identifies in Davidson's account of intentionality.[107] Davidson assumes that he is dealing with a case of intentional action and then seeks to find an accurate description of it in terms of the psychological states that preceded it. Vogler identifies this as an inferentialist approach to practical rationality, built on the idea that inferential connections between the propositionally expressed contents of psychological states is enough to causally explain action. The view supposes, "…that since we have a true description of the event, since the event involved movement, and since the agent might have made such movements intentionally, we have a true description of an action. The motor here is inferentialist: we assume that a content-sensitive link between psychological cause and behavioral effect is enough to give us action."[108]

As will become apparent, the content of psychological states *does* figure into practical rationality, but not as a causal determinant of intent. Purely psychological accounts of intentionality fail to resolve the difficulties found in Davidson's own counterexamples. Descriptions of the psychology of agents before they act do not successfully ground distinctions between intentional action and mere bodily movements or the unforeseen effects of behaviors.

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[107] Anscombe, "Practical Inference."
[108] Vogler, "Anscombe on Practical Inference," 443.

We need an alternative account of intentional action, but such an account is not intuitively apparent, undoubtedly due to the difficulty of characterizing intentionality as a feature of not just action but consciousness generally. If psychological explanation of action in terms of the causal antecedents in an agent's beliefs and desires fail to adequately explain intention, we may be too close to our own intentions to understand them further than mere brute facts of consciousness. Perhaps, there is no adequate explanation of the intentionality of performance that can be used as the basis upon which to map the intentional use of mobile devices by audiences of live performance. My particular project of leveraging the conceptual structures of creativity used in theatre and performance studies to aid in the practice and theoretical development of human factors in human computer interaction and interaction design would be stymied if not rendered impossible. Of course, I don't believe that this is the case and will appeal to Anscombe's account of intention to get out of this quandary. But, before turning to Anscombe, consider a brief account of intentionality and consciousness put forth by Shaun Gallagher and Dan Zahavi in *The Phenomenological Mind*.

Instead of describing intentionality solely as a property of the mind, Gallagher and Zahavi appeal to the phenomenalist argument that it involves a close relation of mind and world. “On the face of it,” they state, “*what the experience is like* and *what it is of* are by no means independent properties. Phenomenologists have typically argued that every appearance is an appearance of something for someone.”[109] Gallagher and Zahavi subsequently articulate this view of intentionality as an integrated relation between mental content and phenomenal experience, “It is not possible to account for the intentionality of my experience [(what an experience is *of*)] without

[109] Shaun Gallagher and Dan Zahavi, *The Phenomenological Mind : An Introduction to Philosophy of Mind and Cognitive Science* (London; New York: Routledge, 2008), 119. emphasis theirs.

accounting for the phenomenal aspect of the experience as well [(what it is like)], and it is impossible to account for the phenomenal aspect of the experience without referring to its intentionality."[110] Gallagher and Zahavi are here discussing the relation between phenomenal *experience* and mental content, or how we conceptualize the objects of our experience, but their integrated approach to the intentionality of experience also holds in the intentionality of action. We will see that in Anscombe's account of intentional action the phenomenal structure of action, particularly revealed logically in the relationship between theoretical and practical rationality, holds a central explanatory role in both our execution of an act as intentional *as well as* our experiential identification of it as intentional. But this logic of intentionality is not "in our heads." It is important to realize the full force of this conceptual paradigm shift in the explanation of intentionality. Anscombe's account of intentionality results in the insight that psychological, causally explanatory accounts of intention fail because they are in fact merely a form of articulation of the intentionality *in an action*; psychological explanations are incommensurable approximations of a type of human rationality and knowledge that is distinctly practical.

Anscombe's theory of action provides an incredibly elegant and supple solution to the dilemma faced by psychological accounts of intentionality. While not immediately intuitive in its application to theatre and performance studies as traditionally examined in terms of action, given circumstances, objectives, and the like, her theory provides a robust approach to re-evaluating that traditional nomenclature and analytic form. Her understanding of the role of belief and desire in providing the *grounds* of action, and these grounds' relation to the intentionality of action, open up an interesting way of understanding audience comprehension, appreciation, and engagement with

[110] Ibid., 121.

live performance.[111] Although her principal work on action, *Intention* (1957), contains much nuance that will go unexplored here, the following examination of her conception of practical rationality and knowledge will prove essential to further analysis of the cognitive science of action and its application to user experience design.

2.3.1 Practical Rationality

The concept of "direction of fit" between beliefs and desires and the world was inspired by Elizabeth Anscombe and has been subsequently used by philosophers of action following Davidson to argue that a desire must necessarily figure in any "causal chain" conception of intentional action.[112] However, Anscombe's point of inspiration was never meant to work as a psychological explanation of action causation.[113] The thought experiment that inspired the "direction of fit" distinction between belief and desire was instead meant to distinguish between theoretical and practical rationality.

In this thought experiment, a man going about town with a shopping list enters a store and begins filling his basket with items on the list. Nearby, a detective carefully observes the shopper and writes down everything that the man puts into his basket, presumably re-creating the man's

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[111] The anscombian approach to what it means to act with intention also sheds light on more recent developments in actor training techniques and shows how a theory of action can be applied in fields of lighting, scene, and costume design. Extending the analysis into these areas is far beyond the scope of this dissertation, but the applicability is there.

[112] See for example, James Lenman, "Belief, Desire and Motivation: An Essay in Quasi-Hydraulics," *American Philosophical Quarterly* 33, no. 3 (July 1, 1996): 291–301; and R. Jay Wallace, "How to Argue about Practical Reason," *Mind* 99, no. 395 (1990), 355–85.

[113] G. E. M. Anscombe, "Intention," *Proceedings of the Aristotelian Society* 57 (January 1, 1956), 732; Vogler, "Anscombe on Practical Inference," 968; Betsy Isaacson, "5 Alternative Heads-Up Displays That Aren't Google Glass," *Huffington Post*, March 4, 2013, http://www.huffingtonpost.com/2013/03/04/google-glass-alternatives_n_2735818.html#slide=2135424.

own shopping list.[114] In this example, the two lists represent propositional content in the minds of the two men, but they exhibit differing forms of rationality. In the case of the shopper, he may desire to retrieve butter from the shelf and his reaching for the package results in his altering the world in which he is contextualized. The detective might infer that the word-to-world direction of shopper's desire results in his altering the world so that his basket contains a package of butter. The detective accordingly writes down “Package of butter” on his list of items that the man buys. However, the detective's inference reveals a world-to-word direction of fit in his belief about the shopper. He alters his belief about the state of the world based on what he witnesses (or believes that he witnesses) in it.

This may seem like a game of semantics concerning who believes or desires what, but it is not. Anscombe argues that it reveals two differing types of rationality at work: theoretical and practical. In the case of the shopper, a mistake in his rational process will result in the wrong items being placed in his basket; he picks up margarine rather than butter. When he arrives home and discovers his mistake, he cannot merely scratch off “butter” from his list and replace it with “margarine.” Correcting the mistake requires altering the state of the world in which he acts.[115] In the case of the detective, a mistake of reasoning is corrected by merely changing his belief. The detective is operating under principles of theoretical inference, while the shopper's rational process is practical, involving action in the world.

It might be argued that the shopper either consciously or at some subconscious level had engaged in an inferential calculation involving his desire to acquire the items on his list, belief of how to go about doing that, and subsequent action. Anscombe does in fact trace what such a

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[114] Anscombe, “Intention,” ’a732.

[115] Of course, he may decide, “Margarine will have to suffice,” but this only illustrates the breakdown of belief-desire causal explanations of action.

practical syllogism looks like, and I will discuss some of the specifics of that syllogism below. But it is important to have in mind at the outset that for a number of reasons Anscombe insists that the shopper need not progress through a rational inferential calculation in order to reason practically and in order to act intentionally. Practical rationality is nothing like the inferential process that the detective goes through when giving an account of what that the shopper did, and *why* he did it.

An inferentialist perspective about practical rationality might attempt to reconstruct the shopper's historical psychological state at the moment of reaching for margarine by saying that he *desired* to follow his list and *believed* that his list included butter. We can therefore construct a logical inference that Davidson argues is *causally related* to the shopper's act. However, Anscombe argues that this type of inferential calculation need not be attributed to the agent in order for the action to be intentional. Instead, we attribute some sort of inferential calculation to an action if it is already deemed to be intentional. A reason for this can be seen in Anscombe's differentiation between two aspects of belief: the psychological and the propositional. She writes,

> We would never think that the validity of '*p*, if *p* then *q*, therefore *q*' was to be expounded as the entailment of 'X believes *q*' by 'X believes that *p* and that if *p* then *q*'. It is, we feel, the other way around.
>
> Beliefs are psychological dispositions belonging in the histories of minds. But also a belief, a believing, is internally characterized by the proposition saying what is believed. This is (mostly) not about anything psychological; its meaning and truth are not matters of which we should give a psychological account. Propositions, we say, are what we operate the calculi of inference with, for example the calculus of truth-functions…. We then display it. Certainly what it is *for* is, for example, to pass from beliefs to beliefs. But we should throw everything into confusion if we introduced belief into our description of the validity of inferences. In setting forth the forms of inference we put as elements the propositions or we use propositional variables to represent them.[116]

This argument pertains to the relation between the logic of practical and theoretical inference. As Frederic Stoutland explains, the aim of theoretical reasoning, according to

[116] Anscombe, "Practical Inference," 26–27.

Anscombe, is true belief, while the aim of practical rationality is good (desirable) action.[117] We can construct the set of premises and conclusion that propositionally explain an action using a form of inferential calculus based on the meaning and truth of the propositions that make up the premises of the argument. But this calculus need never reference any agent's psychological states. While the detective watching the shopper is undoubtedly attributing such states to the shopper, his assessment is based on the perception that these psychological states are entailed by a logic *internal* to the shopper's actions. This difference in the psychological and inferential aspects of beliefs and believings must be reflected in the way that we understand the logic of action. Vogler describes the impact of Anscombe's distinction,

> …if our objective is to understand *episodes of reasoning* (practical or theoretical) in the life histories of agents, we will be restricting our attention to what we take it that the agents know, and how what they know shapes what they come to do or think. But mapping the inferential content isn't like chronicling events. It is, if you like, part of the business of figuring out whether things happen as they ought to have happened, given what the agent was onto and her circumstances. But that doesn't make representing the inferential relations among contents into a history lesson.[118]

Anscombe argues that Davidson confuses practical and theoretical rationality, reducing the former to the latter. According to the inferentialist, practical rationality is nothing other than theoretical rationality with a decision to act tacked onto the end of it. The inferentialist argues that just as we may identify the logical connections among beliefs that might explain an action, these logical connections are used by agents to arrive at a decision to act. Anscombe argues that practical

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[117] Stoutland, "Introduction," 40. Like belief, desire also plays a role in practical rationality. I will return to this in a later section.

[118] Vogler, "Anscombe on Practical Inference," 33. Inferential relations among psychological contents are not the historical causes of subsequent actions. Emphasis on "episodes of reasoning" is Vogler's, but I might also point out that propositionally expressed inferential content serving as the basis for determining "…whether things happened as they *ought* to have happened given what the agent was onto and her circumstances," will become important to understanding why the expression of intention is different than the intention *in* action and why both are important dynamics in live performance.

rationality does not appeal to the psychological history of agents in order to provide a logically sound practical syllogism.

According to Anscombe, we do not identify the intentionality of an action in the logic of the theoretically expressed beliefs and desires of the agent; rather the mark of the intentional lies in the applicability of the question "Why?" to a particular description of an act. The question "Why did you do X?" only has applicability if our description of the act ("X") is first admitted by the agent as an accurate description of his action. This means that we recognize intentionality in an act *prior* to our propositional articulation of it—a central point in Anscombe's theory of intention. If the "Why?" question is denied applicability by the agent, then the act was not intentional *under our description of it*. If the applicability of "Why?" is the mark of the intentional, but the description under which the "Why?" applies presupposes the intentionality of the act, then there must be something upon which we base our descriptions of the act.

The rational articulation of intentional action identified in our descriptions of action is not strictly speaking "in the head" of the agent; much of action's rational structure is located in the world in which the agent pursues her end. Vogler provides this clear analysis of Anscombe's objection to Davidson, "Davidson mistakenly thought that he needed [a causal] account…because he wasn't paying attention to the rational structure *in* intentional action, and thereby wasn't noticing that, if the event-to-be-explained was intentional action, then it had an intended means-end or part-whole articulation relevant to its representation and to understanding its grounds."[119]

I will now turn to that means-end, part-whole structure and its implications for action as a whole.

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[119] Ibid., 19.

2.3.1.1 Action Displays a Structure

The means-end, part-whole construction of action provides the underlying basis for Anscombe's identification of the question "Why?" as the *mark* of the intentional. Frederick Stoutland explains that for Anscombe, "…no action is intentional in virtue of the applicability of [the "Why?"] question nor in virtue of its actually being done for a reason."[120] Rather,

> The reason the "Why?" question applies to certain events is that the description of those events presumes the applicability of the question. There are events whose description "is a type of description that would not exist if our question 'Why?' did not. It is not that certain things, namely the movements of humans, are for some undiscovered reason subject to the question 'Why?'." That is no more the case than that certain marks on paper are for some undiscovered reason subject to the question "What do they say?" "It is of a word or sentence that we ask 'What does it say?' and the description of something as a word or sentence at all could not occur prior to the fact that words or sentences have meaning."[121]

The existence of intentional actions leads us to ask "Why?" in the relevant sense, and this "Why?" is a prerequisite to the existence of a *description* of the action that answers the question. Actions are intentional by nature, and that nature is in part discovered in their means-end and part-whole structure.[122]

In the above section on Aristotle's conception of poiesis, I examined how he differentiates between techne and phronesis based on the structure of the actions that comprise a poetic work. Techne is a composite of actions, each done in order to accomplish something else, and each

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[120] Stoutland, "Introduction," 26.

[121] Ibid., 42, quoting Anscombe, "Intention," 83. Perhaps helpful here, Stoutland summarizes Anscombe's sense in which the "Why?" question applies to actions. He states, "Anscombe now gives a more informative account of what distinguishes intentional actions from other events. They are actions to which a certain sense of the question "Why?" applies, as follows. The question has that sense if the answer mentions a motive: past history, an interpretation (redescription) of the action, or something future. It does not have that sense if the answer is that "I was not aware I was doing that" or "I observed that I was doing that," or "if the answer is evidence or states a cause, including a mental cause" [24]. It is not refused application even if the agent answers that he acted for no reason ("I was just doodling"), "any more than the question how much money I have in my pocket is refused application by the answer, 'None' " [25]. It also applies if the answer is "no particular reason," provided we can make sense of a man who so acts—for example, spreads out his green books all over the roof of his house. The answers to the special question "Why?" therefore go beyond reasons for action; that question "can now be defined as the question expecting an answer in this range" [28]." (Stoutland, 2011, 37; quoting Anscombe 1956)

[122] Stoutland, "Introduction," 42.

forming an additive component of the finished work. Each action is instrumental toward some foreseen end extrinsic to the series of actions that comprise it. We can see how and why this internal, teleological striation of action will lead to the question “Why?” serving as the primary mark of the intentional. If one's final goal requires the execution of several actions, each sequentially building in the attainment of that end, then two things become apparent. First, the relations and structure *in* our movements convey the intention *with which* we act by virtue of each movement being performed *in order to* bring about that end. When each act is *in order* to bring about some other act or some other end, a logical structure emerges implicit in the sequence of the acts themselves. Second, our description of the act is derived from that structure and the end it seeks.

This basic teleological account of intentional action confronts several objections that demand a further nuanced account of the internal structure of action. These objections reveal a) the role of the circumstances in a teleological account of intention, and b) the natural controls for truthfulness in descriptions of action. Additionally, we will see that c) in some cases, two strands of intentional action may overlap or intersect, but the set of shared acts between the two overlapping strands of intentionality may nonetheless be distinguished by their differing answers to the question “Why?”. Finally, d) in cases where the intention of a sequence of actions is difficult to determine from their means-end, part-whole structure alone, Anscombe resists both the conclusion that intention is a purely interior mental phenomenon *and* the alternate behaviorist position in which intention as a mental state is characterized by what we do. Rather, Anscombe resolves this difficulty by discovering the logical differentiation and interlocking of motivation and intentionality in action. The former is describable in terms of psychological states such as belief and desire, and it specifies the end sought in action. The latter, while also directed toward

the end described by a rich psychology of motivation does not entail a reference to the agent's psychology. As Stone and Moran explain, we can apply [propositional, psychological] descriptions under which an action is intentional without assuming that the creature performing the actions has those descriptions in mind.[123] The logical structure involved in planning an action (practical inference) is dependent on and derived from the logic of practical rationality *in* action. But a practical syllogism begins with the statement of an objective that is "off to the side," so to speak. This statement specifies what the syllogism aims at, but it is not one of the premises of the practical syllogism. Rather, this objective arises from the motivational grounds of an action, which nonetheless do not *cause* the action. Hence, we can see that the mirroring and interdependence of logical structures in theoretical and practical rationality demonstrate the importance of intentional action to our understanding of mind in the world.

Anscombe provides a useful, well-known thought experiment in which a man moves his arm up and down in order to operate a pump in order to fill a water cistern, in order to supply water to a house, which is "…regularly inhabited by a small group of party chiefs, with their immediate families, who are in control of a great state; they are engaged in exterminating the Jews and perhaps plan a world war."[124]. The water has been contaminated with a cumulatively lethal poison that will go undiscovered until its effects are irreversible. The man is employed in service to the house, and is a co-conspirator to the person who laid the poison.

If we ask what the man is doing, there are a number of ostensibly valid descriptions of his act.[125] He is moving his arm up and down. He is pumping water. He is filling the cistern. He is

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[123] Richard Moran and Martin J. Stone, "Anscombe on Expression of Intention: An Exegesis," in *Essays on Anscombe's Intention,* ed. Anton Ford, Jennifer Hornsby, and Frederick Stoutland (Harvard University Press, 2011), 73.

[124] Anscombe, "Intention," 37.

[125] The following discussion is taken from Anscombe, "Intention." §23-27.

poisoning the inhabitants. The question, Anscombe asks, is what constitutes the right description of what he is intentionally doing, and *why* is it the right description?[126] For example, in addition to the above descriptions of his action, he may also be casting an interesting shadow on the rockery, or generating certain electro-chemical reactions in his nervous system. We can limit the scope of descriptions that serve as valid descriptions of an intentional act to only include those which the man himself allows as valid descriptions of his act when posed in Anscombe's "Why?" format.[127] If the man responds by saying that he did not know he was doing the act under our description, then the act is not intentional. Nonetheless, we still have at least four descriptions of what the man is doing (moving, pumping, filling, poisoning). Do these descriptions constitute four distinct intentional actions or a single action; what is the nature of the relationship between these "doings" by the man?[128] We might want to say that he is doing all of these individual actions. However, Anscombe points out that in this sequence of actions, there is a "break" between "filling" and "poisoning." How does filling the cistern *count as* poisoning the inhabitants when that last act is neither immediately spatial-temporally related to his act nor is it observed in the moving, pumping, and filling.

The man's legal defense team may leverage the distinctness of the man's "doings" to argue that he at no time poisoned the inhabitants. He was merely *laying* the poison, and given that it was cumulative, there was never a point in time when he poisoned them. Anscombe points out that this argument reveals the difficulty of drawing a correlation of identity between the act of poisoning the inhabitants of the house and the act of pumping water. Due to the poison's cumulative effect, at no specific time did he do anything that by itself could count as poisoning the inhabitants, at

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[126] Ibid., 37.
[127] Her formulation of the "Why?" question has much nuance that cannot be discussed here. See Ibid., 9–34.
[128] This constitutes the commonly discussed problem of action individuation.

least not lethally. “For in the acts of pumping poisoned water,” Anscombe argues, “nothing in particular is necessarily going on that might not equally well have been going on if the acts had been acts of pumping non-poisonous water.”[129] So, how do we describe the act of pumping as the act of poisoning, keeping the intention in tight relation to what the man *does*? We can easily see how a series of cumulative poisonings counts as intentionally poisoning, but this is not because of anything that we identify as having gone on in the man's head. Rather, we can see the logic of the relations between moving, pumping, filling and poisoning as we “open up” our consideration of the action in relation to a larger set of temporal, spatial, and conspiratorial circumstances surrounding his individual, behavioral doings. This “opening up” of an action within its circumstances will become increasingly important to this discussion.

Anscombe next looks at a case where it is difficult to see how the teleological structure of the man's behavior plus the broader circumstances surrounding what he does can effectively determine the intention in the act. It may be that the man does not care one way or the other whether or not the inhabitants are poisoned, he merely wants to keep his job and reasons that performing it as he usually does is the best way to remain employed. He may in effect poison them knowingly, but without concern. This problem of double-effect appears frequently in philosophy of action as well as ethics and morality discussions. Before we can begin to deal with double-effect specifically, we need some form of proof that the man is not lying about his claim to be merely doing his job. A partial control for the truthfulness of his claims can be discovered by observing his future acts

[129] Ibid., 41. Anscombe also points out that nothing in particular is necessarily going on that might not equally have been going on if the man had not known that the water was poisoned. But we must also remember that an appeal to ignorance only *sometimes* provides valid ground for denial of intentionality.

to see if he does anything that would betray complicity with the conspirators or delight in their success.[130] This control for truthfulness, while helpful, does not always work.[131]

Anscombe also rejects the idea that the man can form an intent by merely making a little speech to himself: "'What I *mean* to be doing is earning my living, and *not* poisoning the inhabitants.'"[132] Such a speech, as a speech, is hardly the determinant of the intention with which he acts. However, if we control for the truthfulness of the man's answer to our question "Why are you poisoning the inhabitants?", and if we agree that his answer as a conscious declaration *per se* cannot determine his intent, there may yet be cases in which there is no noticeable difference in what he does when poisoning or when merely earning his pay. If Anscombe's model of intention is to hold up, she must demonstrate how the intentionality of an act is found in what he *does*, as opposed to some mental state *interior* to the man.[133] As she roughly puts it, she must show that we intend to do what we do rather than intending to do some objective we hold distinct from our actual behaviors. Our intentions are thus distinct from and *not* described by our objectives.[134] Within common parlance and performance analysis, we almost invariably conflate objectives and intentions. But if objectives are distinct from the practical rationality of intention, then Anscombe's point can help us distinguish between how we reason practically and how we *talk about* our reasons in acting. This distinction will reveal the importance and unique contribution of theatre and performance studies and why our study of action cannot be replaced by language-based analysis. As will be discussed later, the importance of objectives lies in their relation to desires. We might

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[130] Like the response to his legal team, this reliance on the broader set of circumstances revealed in future actions shows how intentionality lies in an act rather than in the willing of the person doing it. Ibid., 43.

[131] Anscombe makes this point at Ibid., 44.

[132] Ibid., 42. 45}

[133] Ibid.

[134] Ibid., 44–45. More on objectives below.

oscillate between several desires as we go about performing an act, but in the end, the logical structure of our intentions only tangentially relates to the objects of our desires and does not appeal at all to our *desiring* those objects. Anscombe introduces the logic *in* action by what she describes as the way that actions "swallow up" one another.

The problem of action individuation reveals the difficulty of defining the relationship between moving one's arm up-and-down *in order* to pump *in order* to fill the cistern *in order to* poison the inhabitants. These are all individual "doings" by the man, and unique relationships hold between them. Each action is dependent on the previous action but independent of the following actions. For example, a man must move his arm up and down in order to operate the pump; pumping just *is* moving one's arm up and down. But operating the pump does not necessarily result in the filing of the cistern; the action can be interrupted. Another way of saying this is that each act is a means to the act following it, and this progress toward a final act can always be interrupted in some way. A concomitant point arises if we work our way back down the action sequence; each act is not necessarily a *description* of the act that precedes it. Moving one's arm up-and-down is not necessarily described by "poisoning the inhabitants." Moving his arm up-and-down and even pumping can be done without so poisoning. The final-to-initial act relation is built on the way that the initial action answers the "How?" of the final act. Pumping tells *how* the poisoning was done despite the fact that poisoning does not describe pumping.

These characteristics of the relationships between the individual acts that make up a complete action apply universally. Nick moves his fingers across the keys of his saxophone in order to play "Giant Steps," in order to perform the recital, in order to please his teacher.[135]

[135] Nicholas Wolterstorff provides this example as a description of what he calls "Action Trees." See Nicholas Wolterstorff, *Works and Worlds of Art* (Oxford University Press, USA, 1980).

Furthermore, these relational characteristics are based on the broader context in which the action occurs and is described.[136] It is a sequential "opening out" of the action within this broader context. Moving fingers in a certain way has incrementally more meaning in a world where there are saxophones, where there is the composition "Giant Steps," where there are recitals and teachers. In order for the conspirator's up-and-down arm movements to count as pumping, the pump must be of a certain type. In order for pumping to fill the cistern, a conduit must exist between pump and cistern. In order for filling the cistern to count as poisoning, the water must contain the poison. Each subsequent description of what the man does appeals to a wider set of circumstances in which he acts. It is the act itself within its given circumstances, not our description of the act itself, that makes that act *count as* what follows it.[137] That expanded comprehension of the circumstances is all that is needed for one action to "swallow up" the prior action. The man need *do* nothing more. The mark of this swallowing up is that the final action works as an answer to the "Why?" of the initial action. Each is part of a series of means to that end.

The idea that the intentionality of an act is not "in the head" of the agent may seem counterintuitive. I have already briefly discussed Anscombe's answer to the fact that we often apologize for actions with the caveat "I didn't realize I was doing that." Lack of knowledge renders the act unintentional, but this would seem to imply an important component of intention *internal* to the agent is at work. I cannot delve into lack of knowledge specifically, but I hope that in what follows the answer will become apparent. More important are two other seeming contradictions to the identification of intention in what we *do* rather than in our psychological states. First, how does the structure of action account for the problem of double-effect in which a single action can have

[136] Anscombe, "Intention," 46.
[137] Ibid. See also Nicholas Wolterstorff on Count Generation Wolterstorff, *Works and Worlds of Art*.

two distinct effects? Secondly, how does Anscombe's theory account for the fact that we often engage in what might be called "pure intending" before we actually set about *doing* anything? First things first.

To revisit the beginning of Anscombe's account, there may be any number of descriptions of what the man does, such as casting a shadow on the rockery as he pumps, many of which are not intentional actions. However, there may also be acts that *are* intentional but are nonetheless ancillary to the primary intention of poisoning the inhabitants. For example, the man may click out the rhythm of "God Save the King" while he pumps. Obviously, he moves his arm up-and-down in order to operate the pump in order to click out the rhythm. Two intentions in action, one set of doings by the agent. Anscombe argues that the "Why?" of moving his arm up-and-down is explained by "…in order to poison the inhabitants," but this same "Why?" is answered by "…in order to click out a rhythm." We can therefore see that poisoning and clicking out a rhythm are both present in the teleological structure of the action, but how are they distinguished? Poisoning does not explain *why* the man clicked out the rhythm, nor does clicking the rhythm reveal *how,* in any important sense, he poisoned them. Clicking a rhythm is no means to the end of poisoning, nor does it constitute a part of the whole action. There is nothing about the circumstances that make rhythm-clicking part of the intentionality found in the act of poisoning the inhabitants.[138] Hence, the two streams of intention converge in what the man does, but their differentiation lies in the explanation we give them. Vogler observes that,

> A strict inferentialist will have a lot of trouble making sense of the intended-foreseen distinction in practical philosophy. But if we notice that the first line of transmission of intention in practical reasoning, practical inference, and intentional action is along the means-end, part-whole calculative lines, we will see that merely foreseen consequences, however epistemically warranted, fall outside the calculative order in intentional action.

[138] See Anscombe, "Intention," 46–47.

This, in turn, reveals a very significant difference between theoretical and practical knowledge.[139]

The remaining problem for Anscombe's teleological theory of intention, the apparent phenomenon of pure intending interior to an agent prior to action, is likewise resolved by the difference she identifies between practical and theoretical rationality. Specifically, these differences are seen in the distinction between what an agent *does* and our *explanation* or *description* of it. Clearly comprehending this distinction requires careful examination of the logical structure of theoretical and practical rationality, with a primary difference lying in the end sought by practical rationality as it is expressed through an "expanded description." I will attempt to be as brief as possible on these issues while attempting to demonstrate their helpfulness. The answer to the problem of pure intention displays provocative explanatory fecundity for theatre and performance studies as well as human-computer interaction.

2.3.1.2 Practical Rationality|ytilanoitaR laciteroehT

In Section 43 of *Intention*, Anscombe states that, "Description of a human action is something enormously complicated, if one were to say what is really involved in it--and yet a child can give it such a report."[140] Consequently, Anscombe leverages Aristotle's idea of the "Practical Syllogism" in the *Nicomachean Ethics* as a first step in understanding descriptions of action. She points out that Aristotle's syllogism and her own order of "Why?" questions, "…reveals the order that there is in this chaos [of description]."[141] Vogler points out that in Anscombe's story of the shopper and detective, the lists of both men could have been identical if the shopper had practically

[139] Vogler, "Anscombe on Practical Inference," 460.
[140] Anscombe, "Intention," 79.
[141] Ibid., 78–80.

executed the contents of the list.[142] Hence, her dismissal of our descriptions of reasoning in action as a key determinant of what is distinctive of this reasoning should not surprise us. Nonetheless, as we progress it will become increasingly clear that the expression of this descriptive content nonetheless plays a key role in her argument.

In Book 7, chapter 3 of the *Ethics*, Aristotle sets up the practical syllogism as beginning with a major premise that defines a universal, which is followed by a minor premise stating the particular situation at hand. Anscombe provides a classic example of this type of reasoning:

"Pure water is wholesome;

This water is pure,

followed by drinking the water…."[143]

She then examines some of the problems with Aristotle's formulation of the logic of action. Chief among these problems is the defeasibility of action as clearly seen in the disjunction of possible conclusions (drinking water *or* pouring it on the ground when one's enemies may get at it; killing one's father and marrying one's mother *or* seeing a psychiatrist to resolve these Oedipal desires you have, etc.) all validly concluding the practical reasoning.[144] These difficulties for Aristotle's formulation prompt Anscombe to propose a revised model of the syllogism with the purpose of showing that the distinct "form" of practical inference lies in 1) its placing certain propositions in a "quasi-imperative form," and 2) the arrangement of the logical terms.

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[142] Vogler, "Anscombe on Practical Inference," 451.

[143] Anscombe, "Practical Inference," 6.

[144] See Anscombe, "Intention," §33; Anscombe, "Practical Inference," 7. Additionally, Aristotle's examples are closely formulated in order to match theoretical reasoning, but they do not in fact conclude logically in an action. We can generalize for omissions of action, but this is not helpful in determining reasoning about actions. Arithmetic or dancing (i.e. arts or techne) differ from other cases in that we can in some instances make a general positive rule for acting in these spheres. These limited cases are, of course, interesting to the argument of this dissertation, but not sufficiently so to demand extended comment.

Constructing this alternate logical form of the practical syllogism enables her to illustrate the similarities and differences of practical and theoretical inference.

Because the propositional content of both theoretical and practical syllogisms are the same, what is distinctive about the latter is how the structure of reasoning is *used*. Stoutland shows how theoretical reasoning, for Anscombe, "…aims at true belief and practical reasoning at good (desirable) action. The starting point of practical reasoning is something wanted, its aim is action, but the reasoning does not mention (describe) either the agent's wanting or his acting."[145] While the thing wanted by the agent, the object of desire, may begin Anscombe's practical syllogism, it is not strictly speaking part of the syllogism. Rather, it is set off to the side of that bit of logical reasoning, which does not mention the agent's actually wanting anything. The conclusion of the syllogism mentions what the agent must do to get that object of desire—it ends in a proposed action. Anscombe writes,

The starting-point for practical inference is the thing wanted; so in representing it we put that at the beginning. Then there are the considerations (to which I formerly restricted the term "prem-ises") and then there is the decision, which we have agreed to verbalize. So:

Wanted: that *p*. (Or: Let it be that *p*.)

If *q*, then *p*.

If *r*, then *q*.

Decision: *r!*

While for theoretical inference the starting-point is something asserted or supposed:

r. (Or: Suppose *r*.)

If *r* then *q*.

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[145] Stoutland, "Introduction," 40.

If *q* then *p*.

p.

The change of mood and different order of the same elements give what may be called a different form. But that is all.[146]

The form of the two syllogisms demonstrate a reverse or mirrored structure, and the logical relations among the various terms are the same; what changes is the *use* to which we put these hypotheticals and their logical relations. Anscombe thinks that the hypotheticals "…are not asserted but propounded as *possibilities that can be made true*."[147] They show the good of the action (Decision: *r!*), and thereby establish its grounds. But these grounds do not necessitate the agent's execution of the act.[148] For all of the logical validity between "Decision: *r*!" and "If *q*, then *p*.", the agent may never act, or the act may be interrupted before it is carried off.

Furthermore, Anscombe is importantly *not* arguing that everyone who acts tediously goes through a mental practical syllogism prior to the action. This would be planning the action, and agents need not plan out what they are going to do in this way. Indeed, relative to the number of actions we perform daily, planning happens infrequently. However, what happens when we *do* plan out an action prior to its actual performance? It would seem that this is a sort of purely mental intending.[149]

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[146] Anscombe, "Practical Inference," 21–22.

[147] Ibid., 27. Emphasis mine.

[148] Ibid., 11.

[149] Anselm Muller writes, "More often than not, actions are done for reasons without any prior 'engaging in practical reasonings'. But this does not prevent us from attributing to the agent thoughts that articulate those reasons. Their expression can be elicited, for example after the action, and function as a criterion of its purpose and character." See Anselm Müller, "How Theoretical Is Practical Reasoning?," in *Intention and Intentionality*: Essays in Honour of G. E. M. Anscombe, ed. Cora Diamond and Jenny Teichman, Book, Whole (Ithaca, N.Y: Cornell University Press, 1979), 97.

I should also distinguish planning from what I think of as "rehearsing." In this context, planning specifically applies to thinking through an action in propositional terms. We work out things before they occur propositionally as well as behaviorally. The conspirator who fills the cistern may have thought prior to going to work, "Well, if I go on with my job, then the right people will gain control of the government." He might have *said*, "That would certainly

Her answer is to this dilemma comes in two parts. First, although action planning prior to the act does happen, the logic of that planning is derived from the logic internal to the intentional action. Second, while the "Why?" of an act is implicit in its logical structure, this structure also opens the possibility for an *Expanded Description* that answers "*What* are you doing?" The expression of intention in answer to the "What?" of an action further differentiates intention from causation by other mental states such as beliefs and desires, and it leads to further refinement and explanatory fecundity for the conception of action and its use in performance and human-computer interaction.

To begin this exploration of the "What?" of action, recall that earlier I followed Anscombe in arguing that practical rationality is incommensurable with theoretical rationality and said that the propositional expression of an action is merely an articulation of the reason *in* that action. We can now see how this works in the mirroring of the practical and theoretical rational structures of reasoning. It is fairly easy to see how the logic of practical rationality is recognized or repeated in its propositional expression or theoretical inference. However, what is not so easy to see is how and why, if the only difference between Anscombe's model of theoretical and practical rationality is in the arrangement of logical terms and the quasi-imperative form of the practical syllogism, how and why Anscombe maintains that theoretical and practical reason are incommensurable forms of rationality.[150] The answer to this seeming contradiction lies in the fact that the practical syllogism is already a propositional *expression* of the inner logic of the practical rationality in an action. The logical relations that hold between the movements of a single action are in the action,

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be worth going to work today." The man mentally rehearsing how to play "Giant Steps" is doing something much more movement based, and it's most likely revealed in the subtle movements of his fingers. Recent discoveries in the cognitive science of action discussed in the next chapter will lend clarity to this distinction.

[150] Ibid., 21–22.

but their expression in a practical syllogism is distinctly an *expression*, which is why it need not be expressed or planned in order to be part of the action. The expression of an intention is practical logic in propositional terms, which goes beyond that logic. We can see this in the *p*'s and *q*'s above, but it is especially apparent when we consider that those *p*'s and *q*'s generalize more specific expressions of particular situations: pumping, in order to fill, in order to poison. “Pumping,” “Filling,” and “Poisoning” are more than mere behavior, but *what* they are and why it matters for performance and user experience design remains to be explained.

2.3.1.3 Expression of Intention

Moran and Stone begin their excellent essay on Anscombe and the expression of intention with three examples of the concept of intention that begin Anscombe's own *Intention*.

> "(Case 1) Someone says “I'm going to walk to the store”: An *expression of intention*, [Anscombe] says.
>
> (Case 2) Someone is walking (or has walked) to the store: An *intentional action*.
>
> (Case 3) “Why are you walking to the store?”—“To get some milk”: The question seeks—and the answer provides—*the intention with which something is done.*"[151]

Anscombe seeks the common concept of intention that is being employed in all three of these diverse examples. Moran and Stone point out the strangeness of beginning a conceptual analysis of any kind by focusing on the personal expression of the concept under consideration. The reason for this, the authors aver, is that Anscombe is distinguishing between certain human states, like emotion, that are naturally expressive in their behavioral manifestations, and intentions, which are not. Moran and Stone respond to this distinction,

> But the question is, why not? Why say this? The problem which emerges here…is what the relevant notion of “expression” might be, such that it has no application to the intentions

[151] Moran and Stone, “Anscombe on Expression of Intention: An Exegesis,” 45.

> manifested by an agent's stalking movements, while still finding purchase on the nonverbal manifestations of other states like emotion.
>
> The solution to both problems involves seeing Anscombe's emphasis on "expression"…as part of a distinctive strategy for elucidating the unity of the uses of intention [in Cases 1-3]. [This strategy]…exhibits the divisions of intention as inflections of a single form. It thereby also helps reveal how the unity of "intention" has become linguistically submerged, hence lost to a philosophically unassisted view.[152]

We may pose the question differently; what expressive power does Anscombe see in some visible bodily states, like emotions, that she does not see in intentional behavior? This is a very important question because in it Anscombe separates expression of intention from natural behavior. Counter-intuitively, she argues that a behavioral movement is *not* expressive. We have seen how her argument identifies intention *in* the teleological structure of what we actually do, but she also defends a conception of expression in which what we do does not qualify as an expression of that intention. Instead, she says that the "Why?" question elicits an expressive answer, an expression of *what* is being done that expands beyond the intention it expresses.

Moran and Stone argue that later theorists paying homage to Anscombe (e.g. Davidson) mistakenly ignore the above first case's emphasis on the *expression* of intention and restate it as an "intention to act," which is a pure mental intending prior to both acting intentionally and the intention with which we act (some future end we seek).[153] This misreading of Anscombe is the impetus behind these later theorists interpretation of intention as an interior mental state. Moran and Stone write,

> Given the possibility of "pure" intending, it becomes hard to see how this category could fail to designate a mental state, attitude, or disposition of some kind. So the divisions of "intention" now take shape around the philosophical polestar of the division between mind and world: two notions of intention find purchase only where there is behavior causing things to happen; a third refers to a mental state, attitude, or disposition which, though in

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[152] Ibid., 48.
[153] Ibid., 49.

some way present in such behavior, is also abstractable from it and capable of existing on its own.[154]

However Anscombe, as we have seen, is keen to show the intentionality, not in someone's "…mental state, attitude, or disposition of some kind," but rather in what they actually *do*.[155] Thus, it would seem that Anscombe runs the danger of either failing to account for cases of pure intending, or she is committed to behaviorism concerning intentionality. Her solution arises in her central emphasis on the *expression* of intention in the first of the three cases outlined above. Because Anscombe proceeds along the lines of expression of intention rather than pure intention in planning, she shows how expression of intention presupposes and appeals to a logical structure implicit in a planned intentional act while simultaneously introducing a more sophisticated conceptual expansiveness, which an action takes on when grounded upon the cognitive states, attitudes, and dispositions of which humans are capable. These states, attitudes and dispositions will reveal what an action is good for, serving as its motivation, without causing it and without displacing the logic of action implicit within its teleological structure. It is just this structure, which Anscombe uses to argue for a clear conceptual distinction between intention and traditionally considered mental states like beliefs and desires.

The tri-part model of the uses of the concept of intention outlined above demonstrates what Moran and Stone describe as a line of progression in which the agent begins (say on the far left of the line) by wanting to do something. He then progresses to a state in which he is taking steps to bring it about that he has done that thing. Then (on the far right of the line) he reaches a point of conclusion in which the act has been accomplished. This should be reminiscent of Aristotle's progressive structure of action discussed above, and it represents the special problem of intention:

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[154] Ibid., 51.
[155] Anscombe, "Intention," 9.

finding its unity within this diversity of applications. Moran and Stone reveal how this differentiates intentions from mental states,

> This progressive structure [of intention] has no parallel in the case of emotions, desires, or beliefs. Generalizing this contrast, we may say: It begins to specify what is meant by a "state" to note that the progressive form of the relevant verb— e.g., "to believe," "to be hungry," "to be taller than"—isn't used. To join a subject to such a verb, no grammatical discriminations of progressive versus perfected aspect ("was ϕing" vs. "ϕ-ed") are needed, only those of tense; and there is always a good inference from the present ("X is hungry . . .") to the perfect ("X was hungry . . ." said at some future time). States, in short, are static….[156]

If states are static, either had by someone or not, actions unfold over time and reach a moment of completion. Intention must represent this process. Consequently, there cannot be a single *moment* of "pure intending" prior to an act; such talk merely references an expanded description of the action. More on this shortly.

Intentions are also dissimilar to an agent's beliefs, desires, and other "mental states" by virtue of the object that they reference. An intention can be expressed as "He intends to ϕ." This ϕ stands for some performance verb, but this intentional object, being a performance, is also subject to the concept of intention. If one ϕ's, one does so in order to ψ.[157] Moran and Stone point out that beliefs, desires and other mental states are not like this,

> …what makes a belief true (or satisfies a desire) can be propositionally rendered, and is only in special cases characterizable through another application of these same concepts: Not all beliefs are about other beliefs, as not all desires could be merely for other

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[156] Moran and Stone, "Anscombe on Expression of Intention: An Exegesis," 68–69. I might also add that to say that a belief, desire, or emotion is a state is not to say that they are not subject to degree. To see why this is the case, if we claim that states by virtue of their openness to degree display the progressive structure of action, then we would be forced to conclude that there is some maximal degree of belief, desire, emotion that someone must reach in order to have believed, desired, emoted. This is obviously false. While it is true that someone with a beginning twinge of hunger is not as fully hungry as someone who has foregone food for a day. It is false to say that the pain of hunger after a day does not qualify as a desire for food because it is really nothing in comparison to the man who will in a few moments drop dead of hunger. Contrarily, we can easily imagine that the downhill skier who reclines in the lodge after completing her first Double Black Diamond slope will maintain bragging rights over the man who made it down only two-thirds of the same slope and was carried off the hill in a stretcher.

[157] Ibid., 59. Whether or not these chains of action come to an end is an interesting and well-covered question in the literature. it will be briefly discussed briefly below.

> desires…Here, then, it looks as if "intention" earns its literal, archaic sense— a "stretching forward"—for it is structured as action itself is.[158]

There would appear to be several problems with this differentiation of intention from mental states like belief and desire based on an intention's "stretching forward" toward some end. First, what determines that end or object of intention? Second, since we also speak of desires being directed at some object; it would seem that Anscombe is sneaking in a desire into the teleological structure of intention. Third, what determines the conclusion of a series of linked objects of intention? We don't go on doing one thing for the sake of something else *ad infinitum*; our doing must come to some end even if it is only a non-ultimate but final end. I will address these three problems in turn.

2.3.1.4 The End of an Action (the object of desire) is an "Expanded Description"

It is worth recalling that in the practical syllogism Anscombe placed the thing wanted "outside" or "off to the side" of the syllogism. This is meant to show that as the agent works through the means used to attain a given end, she engages in a level of rational calculation that is independent of that pre-defined end. This is the rationality *in* an action, but there is also reason external to the teleological structure of action that guides us to the pre-defined end that begins the practical syllogism. This rationality must figure within an account of intentionality.

The end of an action is something wanted, and Anscombe devotes a substantial portion of *Intention* to examining the rationality of wants and desires that are external to the rational structure found in the intention of an act. Stoutland deftly summarizes this portion of the work,

> …in general her concern here is not with the "Why?" in an action but with the "Why?" of an action, in particular with how the series of "Why?" questions comes to an end with an answer that rules out a further "Why?"—with an answer that cites what we may call

[158] Ibid., 60.

> "ultimate reasons." The focus of her discussion is on the concept of wanting: what is its nature, whether there are limits to what an agent can intelligibly want, how it is connected with pleasure, whether one always wants something as desirable, and whether there are final things that we want.[159]

Anscombe calls these "ultimate reasons" the "desirability characterization" of the act.[160] But if all practical reasoning relies on intermediary premises, back of which is a desirability characterization at the "end of the line," so to speak, based on what is that characteristic desirable and must we then believe that the characteristic compels action? Anscombe's answer to the first question is a qualified withholding of judgment. She argues that the complexity of the concept of pleasure has been grossly misunderstood in modern philosophy; it was baffling to the ancients. But she argues that there is a point at which "it's pleasurable" is a properly basic conclusion of the desirability characteristic and answer to the "Why?" of any action. As to whether or not a desirability characteristic compels action, her answer is decidedly in the negative. A person's wanting something is conceptually connected to the "good" of the thing wanted. I have discussed this earlier when examining Aristotle's argument in the beginning of the *Nicomachean Ethics* that all human action and craft seeks some "good." This leads to a hierarchy of goods culminating in a supreme good, which Aristotle identifies as human flourishing. This is an immensely fascinating topic to which I shall unfortunately have to give only a brief, footnoted introduction.[161]

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[159] Stoutland, "Introduction," 40.

[160] Anscombe, "Intention," 73.

[161] Must we say that if all action is done in pursuit of human flourishing, flourishing compels that action, and since the flourishing of an organism is in large part, if not entirely, a product of the physical makeup of that organism, action is compelled by an organism's teleologically established trajectory (given its situation within an environment) toward flourishing? Anscombe, with Aristotle rejects this notion. The argument against it turns on the way that we know or recognize goods. Anscombe states, "But again, the notion of 'good' that has to be introduced in an account of wanting is not that of what is really good but of what the agent conceives to be good; what the agent wants would have to be characterizable as good by him, if we may suppose him not to be impeded by inarticulateness" (Anscombe, 1956, 76). As Anscombe defers an examination of the notion of "pleasure" to a separate treatise, so also I cannot begin to examine the way that agents conceive things to be good. Undoubtedly, it includes an agent's teleological organization, but it must also include things such as the pleasure that an agent takes in performing an act, which Aristotle links to the lack of hindrance in performing the act. Suffice it to say that if practical rationality is in some way founded upon a desirability characteristic, the desirability of any given act is in large part defined by the individual

However, if a desirability characterization lies at the "end of the line" of practical reason, this does not mean that the agent's desiring or wanting are part of practical rationality. Anscombe distinguishes between the *object* of our want and our *wanting* it.[162] When writing about wanting or desiring, Anscombe is not talking about "the prick of desire at the thought or sight of an object."[163] Rather, it is what we conclude after deliberation and that to which we can habituate ourselves.[164] It may not even be something to which we respond with the prick of desirable or find pleasant for its own sake at all. This distinction between an object of a want and the wanting itself opens up an important point about the expression of intention. "The primitive sign of wanting," writes Anscombe,

> is *trying to get*: in saying this, we describe the movement of an animal in terms that reach beyond what the animal is now doing. When a dog smells a piece of meat that lies on the other side of the door, his trying to get it will be his scratching violently round the edges of the door and snuffing along the bottom of it and so on. Thus, there are two features present in wanting; movement towards a thing and knowledge (or at least opinion) that the thing is there."[165]

These two things, knowledge (or opinion) and moving towards a thing, are sufficient to demonstrate an agent's wanting. We can see the teleological chain of intentionality within the dog's movements. However, as has already been briefly discussed above, there is a "break" within any

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agent. While this does not commit us to a strong relativism about the desirability of actions in regard to our technical designs and products, it does reveal a great deal of ambiguity necessary involved in approaching any design question from the perspective of action. This ambiguity will be explored in more detail in a later chapter.

[162] See Ibid., 72. Also Maria, Ph. D Alvarez, *Kinds of Reasons: An Essay in the Philosophy of Action* (Oxford: Oxford University Press, 2010, for an extended treatment this distinction. While there is some distinction between wanting something and desiring it, I am using the terms basically synonymously.

[163] Anscombe, "Intention," 66.

[164] "And we deliberate not about ends, but about means. A doctor does not deliberate whether he is to cure his patient, nor an orator whether he is to convince his audience, nor a statesman whether he is to secure good government, nor does anyone else debate about the end of his profession or calling; they take some end for granted, and consider how and by what means it can be achieved. If they find that there are several means of achieving it, they proceed to consider which of these will attain it most easily and best. If there is only one means by which it can be accomplished, they ask how it is to be accomplished by that means, and by what means that means can itself be achieved, until they reach the first link in the chain of causes, which is the last in the order of discovery." Aristotle, *Nicomachean Ethics*, 1112b18ff.

[165] Anscombe, "Intention," 68.

series of actions. What was not mentioned earlier is that this break can come in a variety of ways. Anscombe writes,

> Of course 'I ought to do this, so I'll do it' is not a piece of practical reasoning any more than 'This is nice, so I'll have some' is. The mark of practical reasoning is that the thing wanted is *at a distance* from the immediate action, and the immediate action is calculated as the way of getting or doing or securing the thing wanted. Now it may be at a distance in various ways. For example, 'resting' is merely a wider description of what I am perhaps doing in lying on my bed; and acts done to fulfill moral laws will generally be related to positive precepts in this way; whereas getting in the good government is remote in time from the act of pumping, and the replenishment of the house watersupply, while very little distant in time, is at some spatial distance from the act of pumping.[166]

When a cat slows its pace, lowers itself to the ground, shifts its weight to its hind legs and fixes its gaze on a small hole in the baseboard, we say that it is "stalking a mouse." But we could also say that the cat is "crouching" or "hunting" or "playing cat and mouse." The point is that the "reach *beyond* what the animal is now doing" can display an increasing level of complexity of expression, especially for human actions. This "Expanded Description" beyond what one is actually doing can be seen in the indeterminacy of description by what one is doing. Was the man waving violently on the street corner hailing a taxi or hailing a friend? We would have to ask him to find out what good he thought the action was doing.

Many times we do things and provide "reasons" for our actions that lack sufficient conceptual clarity or sophistication. As Anscombe states, "We must always remember that an

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[166] Ibid., 78. But Anscombe says that we should not make too much of this distance, "…is there much to choose between 'She is making tea' and 'she is putting on the kettle in order to make tea' — i.e. 'She is going to make tea'? Obviously not" (Anscombe, 1956, 40). Moran and Stone observe of this passage, "The implication of this is that the notionally mind-characterizing uses of intention differ from the others only in articulating a greater degree of remoteness or uncertainty. That is, they continue— at a different point in the spectrum—the same form of explanation that was most perspicuously seen in the earlier links of the chain: essentially, the fitting of an action into a larger, presently incomplete whole. Call this the teleological structure of action: Action is the kind of thing that rationalizes its sub-parts (those actions done "in order to" do it). As Michael Thompson has argued, this suggests that it is fundamentally intentional actions-in-progress which explain actions, and that it is only on the basis of this primitive structure— an action as a space of reasons—that a more sophisticated development becomes possible: viz., the joining of a psychic expression with a performance verb to create an etiolated form of the same structure in the interest of articulating relative non-presence, remoteness, or uncertainty." Moran and Stone, "Anscombe on Expression of Intention: An Exegesis," 64. -65

object is not what what is aimed at is; the description under which it is aimed at is that under which it is called the object." Anscombe is making a distinction between a "primitive, spontaneous form" of the conceptualization of a desired object and its more formalized expression. The primitive spontaneous form "lies behind the formation of the concept…."[167] The point being that a conceptual, propositional description is an articulation of a base, primitive concept that is not so articulated, and only when it is thus articulated is it able to be called an object of desire. "He killed my father, so I shall kill him" does not entail the bit of practical reasoning that it may become when the concept of revenge is formalized, as is the case with Hamlet.[168]

Because the expansiveness by which we conceive of our actions goes beyond our mere physical movements, we are able to both discern existing and enact new formal relations between facets of the world and ourselves in relation to it. Doing so requires an imaginative appreciation of not just what we do, but what our actions are good for—practical knowledge. The host of cultural expressivity arises out of our capacity to see beyond what we merely do; it involves immense creativity not only in what we do, but how we discover and design the tools and contexts of our creativity. Before closing this chapter with a few preliminary observations in the area of user experience design, a few more comments on practical knowledge are in order.

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[167] Anscombe, “Intention,” 65.

[168] Anscombe's example at ibid. This point about deriving concepts from physical interactions further explains George Lakoff and Mark Johnson's ideas about concept formation. The primitive, spontaneous form of a concept would be the baby crawling across the floor in order to reach a desired toy. The conceptual description is expanded when we describe the baby as "playing ball." When it reaches this stage, it can be included as the prompt of an action about which we can form a practical syllogism, but not before it becomes described as an object. This is because the practical syllogism requires a conceptual, propositional description.

2.3.2 Practical Knowledge

Philosopher Timothy Chappell illustrates the unique contribution of Aristotle and Plato's conceptions of practical and experiential knowledge in contrast to theoretical knowledge. He argues that experiential and practical knowledge (or knowledge-how) may be mutually reinforcing and we may use one to expand our knowledge in the other (for example, riding a bike often involves an interplay of experiential knowledge and know-how), but they are nonetheless separate forms of knowledge. He states:

> The real point about the differences between the varieties of knowledge is not a point about inexpressibility, or about whether instances of one variety of knowledge can be marshaled into line so that they match one–one with, or are perfectly parallel to, instances of another variety. More basically and simply, it is just that the lines would always be parallel and not coincident, because the varieties of knowledge are varieties, different operations of the mind. They are simply different things. Even if your radio is tuned to the perfect cricket commentary, where every minutest nuance of the match is picked up, still listening to a radio commentary is a quite different thing from attending a match. Likewise with the varieties of knowledge. When we think clearly about examples it is, as they say in maths, just evident on inspection that knowing how is a different kind of thing from experiential knowledge, and that both are different from propositional knowledge.[169]

As Chappell indicates it seems intuitively obvious that we often simultaneously operate with differing forms of knowledge about the same object. Anscombe's examination of the differing structures of theoretical and practical rationality begins to shed some helpful light on why these differing forms of knowledge are important. She maintains that practical and theoretical rationality have the same subject matter (or object), their difference lies in the structure of the reasoning process. Just as the man buying groceries and the detective observing him are both intent on the same objects, what the shopper is doing, the detective's logical inferential explanation of action

[169] Timothy Chappell, "Varieties of Knowledge in Plato and Aristotle," *Topoi* 31, no. 2 (2012), 185.

differs from the spatial-temporally grounded process of practical rationality executed by the shopper.

The shopper's spatially extended from of rationality is also evident in his knowledge of his actions. According to Anscombe, perceptual experience gives us experiential knowledge of the world directly, unmediated by a type of "internal" belief structure. This fluid contextualizing of our experiential knowledge directly in the world, finds its mirror image in the direct contextualizing of practical knowledge in the world. Our actions are not mediated by beliefs and desires. Rather, as Stoutland explains, "Walking, running, eating, drinking, pounding, skiing, greeting, writing—ordinary bodily activities all—do not consist of bodily movements plus events they cause; they are our moving our bodies in ways that extend beyond them. We can run or walk only on a surface, that is, only in a world outside ourselves that also acts on us."[170] Action is not bodily movement caused by belief and desire resulting in events in the world. To claim this is to overlook the fact that activity has a structure inseparable from the context in which it occurs. Bodily movements are constituent parts of this structure, which is more than the sum of the movements it includes. Stoutland explains: "The Davidsonian picture has its roots in the Cartesian revolution, which conceived of the physical world as consisting only of what plays a role in the new physics, a physics purified of the teleological, intentional, and normative terms of Aristotelian physics. The physical consists, that is, of the particles and forces of an ideal physics, which as such have neither conceptual structure nor motivational and evaluative significance."[171] The point is that the nature of intentional action is not explicable in the cause-and-effect terms of billiard balls colliding of classical physics. Rather, action arises out of the makeup of the world and the

[170] Stoutland, "Introduction," 30.
[171] Stoutland, "Introduction," 30.

construction of human organisms within it. Water and cabbages are not merely H_2O and organic matter; they are also importantly drink and food. Intentionality is inherent in the formal makeup of humans-in-the-world and is *discovered* in action, not *implemented* through bodily behavior. Again quoting Stoutland,

> It is the nature of animals to eat, drink, fight, hunt, copulate, reproduce: how they do so is partly innate, partly a result of their environment that shapes these activities, and is in turn shaped by them…The world of human beings is richer because we have by nature new kinds of powers that enable new kinds of activities, and hence our world is now one of language, art, institutions, agriculture, factories, tools, machines, buildings, highways, and so on…These are features our world acquired in the distant past but they are now part of the nature of the world into which we were born, which made us what we are with the powers we have, which in turn enable us to reshape that world.[172]

As audiences engage with live performance, they intermittently use both theoretical and practical knowledge. They theorize about what a performer is thinking, what she believes at any particular moment, what she desires to be the case. They also actively direct their faculties as they attend more or less closely to various aspects of the performance and recall similar situations in which they have performed the same, similar or contrary actions to those of the performers.

Using Anscombe's account, we can say that the intentionality inherent in the structure of practical rationality and articulated in theoretical rationality is the link between these various forms of knowledge. I will argue that intentionality in these various forms of knowledge provides the basis for being "caught-up" in the "flow" of a performance. Much of the art of performance lies in properly identifying and aligning the various streams of intentionality—not necessarily in harmonious alignment. Much like the collisions and pratfalls of slapstick comedy, streams of intentionality may also be said to "align" in a less than placid convergence.

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[172] Ibid.

These streams of intentionality are not just a rubric for analyzing a performance. The conceptual structure, motivation, and evaluation lacking in classical physics but present in Anscombe's account of intentionality are just what I want to use in conceiving of the way in which new technology should be incorporated into performance. A human-machine symbiosis in the technologized audience, if achievable, will arise as technology is designed so that the intentionality that guides its use aligns with the intentional flows inherent in live performance. Thus, the intentional structure latent in the design of this technology as it is used in the context of live performance must be accurately identified, understood, and communicated in ways that make sense to user experience designers. Additionally, because the intentionality in practical rationality cannot be reduced to the conceptual explanations given by theoretical rationality, the complete symbiosis of technology and live performance cannot be achieved in strictly theoretical terms. A theoretical construction of this symbiosis is only an approximation of "complete" symbiosis.[173] There is an irreducibly practical component to this symbiosis. Technological creations are seldom correct on the first try and usually always improved in later iterations that incorporate the lessons learned in daily, practical use. Those rare cases in which the product appears to seamlessly fit on the first try into the particular of life for which it was designed are undoubtedly to some degree cases of happenstance. In short, beta testing happens for a reason: some elements of design cannot be discovered apart from practice.[174]

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[173] Undoubtedly, a "complete" symbiosis would involve eons of evolutionary development where the organism as well as the environment are gradually shaped into mutual compatibility. In the present we are always forced to accept approximations, but even as the history of technological interventions into live performance shows us, there are better and worse approximations.

[174] See for example a fascinating article on TechCrunch about the inability to know the true value and effective use of Google Glass prior to its release into beta and beyond. The iPad similarly proved bewildering to the general public until its common use was more or less discovered over time through trial and error. Darrell Etherington, "How Will We Define A 'Good' Google Glass Experience?," *TechCrunch*, accessed April 23, 2013.

2.4 INTENTIONALITY IN DESIGN

Applying Anscombe's highly nuanced philosophical analysis of intentional action to theatre and performance studies as well as drawing helpful conclusions to user experience design is a difficult task. In my foregoing summary of her position, I have, for the sake of clarity and coherence, left much of the application of this analysis to later chapters, as the application will become increasingly perspicuous as I examine some of the cognitive science of action and current practice in UX design. However, a few principals of this application may be drawn from the foregoing analysis.

2.4.1 Teleology in Action: Task Design

The teleological structure of action featured prominently in the first portions of this analysis of intention. This linear progression of action has found expression in design most notably in Donald Norman's foundational study, *The Design of Everyday Things*. Norman outlines “Seven Stages of Action.” These principals serve as the central paradigm for usability design and follow along a path from presenting the environment or potentials for action clearly, to mapping the logical order of steps in tasks as they are directed toward an end objective, to providing feedback from the user's actions. This is, of course, a simplification of Norman's work, but it is enough to see that the teleological structure of action, in its minutia, is crucial to the design of user experiences. Anscombe's analysis of intention, will explain and clarify some of the points in Norman's framework, and it should be apparent from my intentional account of Aristotle's theory of *mimesis* that theatre and performance scholars, as experts in action, are well equipped to understand and aid in the design paradigm propounded by Norman.

2.4.2 Theoretical vs. Practical Rationality: Audience vs. Performer

In most of our contemporary performance forms, performers vastly outstrip the audience in performing actions. From Anscombe's analysis, we can say that they are predominantly displaying practical rationality, while the audience quietly observes, contemplatively engaged in theoretical rationality. The performers are the man buying groceries; the audience is the detective taking down everything they “buy.” Or so it would seem.

However, recent work in the cognitive science of theatre and performance studies has made compelling arguments that audiences are not so passive in their experience of live performance. Rather, they are constantly engaged in empathetic engagement with performers. There is also reason to think that many of the actions performed on stage can lead to neural simulation in the pre-motor cortex of an observant audience member's brain. The division between practically rational performer and theoretically rational audience member is not so clear.

While it is difficult (if not currently impossible) to accurately study the neural firing patterns and blood flow patterns of audiences as they watch a live performance, we can nonetheless apply the distinction between practical and theoretical rationality to the performance itself. Performances are themselves “designed” and they usually present audiences with sequences of action that vacillate between a clearly defined teleology and a “hidden” teleological structure. For example, a musical verse and chorus structure establish a clearly defined teleology. Audiences are able to “get into the groove” of the music as they begin to recognize repeated sections. Improvisation, on the other hand, introduces a variation on the pattern and leaves audiences with much more to think about. They do not know what the soloist will do, not exactly, and it is that unknown that enables us to map their cognitive engagement onto the contours of the music. Perhaps, this lacks the neural precision of an fMRI, but it nonetheless provides us with some

conceptual tools (complete with logical syllogistic structures) for understanding types of cognitive engagement when designing an interactive experience via mobile devices—theoretical and practical.

2.4.3 Practical Rationality Takes Time: Tempo, Improvisation, and Interruption

One of Anscombe's points in "Practical Inference" (echoed by Candace Vogler in *Varieties of Practical Reasoning*) is that action takes time. This flow of time is also important in our cognitive understanding and appreciation of music. In musical tempo, the structure, including the melodic structure, of the music is in large part conveyed through the time intervals and accents on beats marking out those intervals within a composition. Daniel Levitin, in *This is Your Brain on Music,* shows how we are finely tuned to detect variations in tempo (noticing variations over 4% of the learned tempo, which differs greatly from how we remember and use pitch). This sensitivity to timing affects our emotional response as well.[175] So, by being so finely attuned to rhythm and tempo, we are finely attuned to the actions that go into producing it.

By offsetting a beat from the standard rhythm, musicians draw attention to that beat and this is used to create the "swing" of Jazz and Ragtime, which Bill Messenger in *The Elements of Jazz*, argues has a large impact on Ragtime's ability to incite movement and dance in the listening audience.[176] Levitin also argues that the use of an off-beat gives the music "forward momentum," which is interesting for its reference to the behavioral, rather than theoretical or conceptual, implications of the musical structure. Syncopation is a way that composers use the established

[175] Daniel J. Levitin, *This Is Your Brain on Music* (Dutton, 2006), 58.

[176] Bill Messenger, *Plantation Beginnings*, Compact Disk, vol. 1, 8 vols., Elements of Jazz: From Cakewalks to Fusion (The Great Courses, 1998).

rhythm of a song to build expectation in the listener, and then surprise the listener with an emphasis in between the expected beats.[177]

If our identification of an off-beat is important, so also is our identification of synchronization. Not only in the synchronicity of beats but also in the grouping of instruments with similar harmonic structures. By attending to their synchronicity with an accuracy of up to several milliseconds, we can coordinate the sound of, for example, the strings in an orchestra and thereby derive their single generation source.[178]

These time sequences establish an expectation similar to the expectation and possibly identical to the expectation that is found in the structure of practical inference under Anscombe's analysis. Because the intentionality of action arises out of the part/whole means-end structure of the actions, audiences may engage in a hybrid form of rationality in which they comprehend the intentionality of the action practically, but also begin (even subconsciously) to assess its structure and logical conclusion, forward momentum, and ostensible end. The difference and interplay between theoretical and practical rationality are the source of an audience's expectation and discovery. Because practical rationality is ordered toward the pursuit of an end, we can sense by the intentionality derived from an agent's being in the world that they hold an "aim" or objective, but the way that the objective is revealed and changes over time is what forms the basis of our anticipation, the accentuation of our anticipation, and our discovery.

What does this mean for interactive technologies? They should leverage this understanding of sequence, means-end, part-whole rationality and sense of expectation. In Nymbus, for example, we have talked about giving the audience agency that can then be manipulated by the artist. For

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[177] Levitin, *This Is Your Brain on Music*. 58,63-64.
[178] Ibid., 77–78.

example, audiences at live concerts sometimes turn on their LED flash spontaneously to form a group lighter effect. We could enable them to turn on their LED from within the app. Additionally, to establish the sense of expectation and sequence, we could have the audience set the flash tempo (or probably follow the musical tempo) of the LED flash by simply tapping on the screen of the phone. At each tap of the screen the LED would flash on/off. We would then enable artists to begin flashing the screen back at the audience. The “swing” of syncopation could be applied here using light. Instead of merely interrupting the flash and holding a steady LED, the artist could add the "and" flash to the audience's 1, 2, 3, 4, LED light flash, making it 1, 2, and 3, 4.

Implicit within this example is the idea of designing interactively, in real-time. Because practical rationality happens *in medias res*, it presents a unique space in which design practice can happen. In the example, the design of the performance happened in response to the spontaneous actions of the audience, but this sort of design process can also be incorporated into traditional user experience design. UX design frequently employs means of providing end users of a product under development a creative space in which to brainstorm ideas of what they would like to see or do with the product.[179] By giving users the tools needed to improvise, designers open up the possibility for the use of practical rationality in the design process. What then needs to be controlled is the context in which the improvisation occurs, to ensure that the improvisations are likely to be helpful. Additionally, the motivations of the improvisations must be carefully examined.

[179] In a distinctly opposite approach, some design strategies use no consultation with end users. Most famously, Steve Jobs told Business Week, “It's really hard to design products by focus groups. A lot of times, people don't know what they want until you show it to them.” Andy Reinhardt, “Steve Jobs: ‘There’s Sanity Returning.’,” *BusinessWeek*, no. 3579 (May 25, 1998): 62–64.

2.4.4 Expression of Intention: Identification and Failure of Objectives

Moran and Stone argue that natural indications of intention (i.e. behaviors) fail to provide three important controls of action: Contradiction, Commitment, Impugning the Facts. By Contradiction, they mean that it takes an expression of intention in order to establish when an act failed to come off as intended. By commitment, they mean that an agent is only committed to her act after she has expressly committed to it, and similarly, what they did can only be impugned in comparison to what they said that they would do.[180] This fact of the expression of practical rationality yields an important observation for user experience design.

Invariably, there will be some failure in the design of a new technology. The problem is determining the cause of the failure, and what can be learned from it. At a recent experiment in interdisciplinary collaboration at Arizona State University, a theatrical director, clown, and acrobat were invited to create a performance piece with the University's newly acquired robot, Baxter. When meeting with the lead roboticist for the first time, the director asked if Baxter could juggle. Upon hearing that it could not, he asked if it could *fail* to juggle. Failure was possible. The experiment proceeded and resulted in a successful performance as well as improvements to the roboticist's own research. It is unclear whether failure at juggling played a further role in the collaboration, but the director intuitively understood the importance of failure for exploration and understanding in practical rationality and expression of intention. Failure reveals when there is a breakdown between the expression of intention and practical rationality. By having a clearly

[180] Moran and Stone point out that, "…Anscombe's distinction bears little resemblance to the contemporary one between the functional roles of belief and desire, defined in terms of different directions of fit between such states and "the world." Instead of "two directions," Anscombe speaks of a difference between a mistake in what was said and a mistake in performance." Moran and Stone, "Anscombe on Expression of Intention: An Exegesis," 78–79.

expressed intention, it is possible to isolate the moment and reason for practical failure. Similarly, a poorly understood failure may be the result of a poorly expressed intention. In one test of Nymbus, we failed to clearly express our intention to the audience, which was most likely the reason for an observed element failure in that test.

Anscombe's analysis of the expression of intention also applies to the way that technology users are incited to action. How do you get someone to want to do something can really mean two things: 1) how do you get them to think about wanting it propositionally, and 2) how do you get them to want it in a primitive, spontaneous form? In order for users to begin forming practical syllogisms about how to get it, they have to be able to conceptually describe it. Hence, in technology design, more complex interactions requiring a degree of planning need to be conceptually describable and designers should look for ways to get the user to describe it conceptually before they go about figuring out how to get it.

I want Nymbus to become the impetus to experience live events differently. Namely, I want people to *approach* live events as dynamic interactive experiences, not just something you go to "see" or "take in." Finding the right way to conceptualize concert going as a new type of experience is crucial to inspiring audiences to want to download the Nymbus mobile application.

Finally, because actions alone do not express intention, uses of propositionally based mobile technology (e.g. Tweet seats) in music concerts may improve the concert experience. If the propositional component actually specifies the intentions of the composer and/or performers in a given segment of the musical piece (it conveys the 'what?' of "what are you doing?"), then it could lead to a greater level of comprehension. It would do so at the cost of distraction from the sensory experience of the intentionality in the music. However, if audiences no longer have the cultural discernment to identify various parts of the musical piece, then they are less aware of what they

are experiencing anyway. The danger lies in providing propositional content that fails to express the intention and instead conveys inessential content that, no matter how interesting in its own right, fails to explicate the particulars of the performance.

2.4.5 Emergence and Discovery in Action: Sandbox vs. Path

At a recent talk at the Mid-West User Experience Design Conference, Steven Anderson outlined two basic models for user experience design: path and sandbox. Path has been the dominant model of design. It is commonly used in task design for productivity tools as well as in gaming. This linear model has a limited number of possibilities presented to the user in sequential order and has a definite end, with only a handful of possible outcomes. Sandbox, on the other hand, provides users with a creative space in which to create their own paths, define their own outcomes, possibly leave the work/play space and return to it. The potential outcomes are only limited by the creativity of the end user. The sandbox model is effectively the model users follow when Internet surfing, and there are a number of computer games (e.g. Minecraft) that follow this design principal. Anderson argued that we need to begin thinking in terms of sandboxes instead of paths. I would like to argue that theatre and performance scholars are well equipped to begin thinking creatively in terms of interactive sandboxes when designing for user experience. But we must refine our vocabulary in order to dialogue with computer programmers and designers.

I have argued that practical inference serves to deliver a linear action plan, "A in order to B in order to C…." This teleological structure of intentional action, as stated above, closely follows the Path-like structuring of computer tasks. However, I have also argued that agents seldom work through this path-like process; rather they engage in a process of reasoning in the act. This means that when designing a technology, we, students of action, offer more than merely the ability to

think through the inferential structure of the actions needed to accomplish a particular goal using the technology. We certainly *can* do this, but we can also enter the design process to determine *in practice* not merely the inferential structures of practical reasoning encoded into the product but also how we *want* to use it in ways not necessarily intended. More importantly, we can examine why we want to use it in these ways. This "why?" may be described in terms of wants and desires, and is based in Anscombe's "desirability characterization."[181]This identification of the motives of action is precisely the work that Anscombe herself attributes to our near-relatives in the humanities, literary critics.[182]

Approaching the sandbox model of design from the standpoint of alternate teleologies presents a great deal of ambiguity in discovery. A user's engagement with a technology is not solely derived from a clearly defined conceptual mapping of the actions needed to use a thing as it is intended to be used onto the designed potentials for action presented to the user in the design of the object. Rather the teleology of the user is allowed to actively guide and shape the agent's decisions to act grounded in what she believes, desires, and feels about the world. It is not merely a world, but a world in relation to his physical, embodied interaction with it. Belief about the facts of the world and one's relation to it shape what an agent perceptually attends to in the world, what potentials for action (Gibson's affordances, but I don't think that Gibson recognized the goal-directed structure in action) she sees in what she attends to in the world, and importantly, the feelings that agent has about what she sees.

Performance artists, through their study of these structures of action and practical knowledge can not only work through the identification of a device's "goals" and the conceptual

[181] Anscombe, "Intention," 73.
[182] Ibid., 19.

mapping of action structures needed to attain that goal, we can also attend to what our bodies, our perceptions, our emotions, and our expressions of intention are telling us in the use of the technology. Through this explorative process, we can quite possibly bring alternate teleologies to the design table. But knowing how, why, and when to bring those teleologies to the table requires a fine-grained understanding of our own active process: why we are feeling the things we feel—whether a repulsion, a delight, an inexpressible tug toward an action? What we are attending to and why does that feature in our visual field "pop"? How do we best express our reasoning through propositional inferences?

We have to discover answers to these questions while remaining "in character" as creative agents. Then we must meta-process our answers in order to determine whether a design choice or proposed alteration to an existing choice brings the product into alignment with our experiences and actions as an integrated, multi-faceted, practically reasoning agent. Furthermore, we must explore these analyses through multiple performances over multiple differing encounters with the object. This is why, for example, designers at Apple Computers spend hours interspersed over weeks opening and closing various configurations of packaging for Apple products. They want to bring a variety of motivations and personal contexts to the design process in order to achieve excellent presentation and functionality for users who are approaching a new experience with the product from multiple perspectives. It is also why designers create "use cases" and "user profiles." These are rudimentary examples of performance-based interaction design are ripe for engagement by theatre and performance professionals.

While artists may bring a level of creativity to the process of building new technical artifacts, and their processes of creation if brought to the design process may yield powerful contributions to that process, if they are to most effectively communicate their creative imaginative

contribution and effectively answer the “why?” that technicians will undoubtedly bring to their design conclusions, they will need to find a way to accurately express themselves. I propose that the key to this type of effective cross-disciplinary expression lies in an understanding that intentionality, while involving a form of knowledge and rationality, namely practical knowledge and rationality, that is incommensurable with theoretical reason, nonetheless it is grounded upon and *expressible* in its various emotional, conceptual, and propositional articulations.

I have attempted to show how Anscombe argues that intentionality cannot be reduced to any of these articulations. Nonetheless, they all in unique ways communicate one's intention in a way that is not only comprehensible to others but also “translatable” in a sense across disciplines, attending to these articulations and understanding their own motivations in the creative act in terms of these articulations will prove crucial to interdisciplinary dialogue. When answering the “why?” of our design choices, which we should assiduously pose to ourselves throughout the process, we must provide answers clearly defined in these articulations of our own intention and we must assess whether or not our intentions, given their articulated grounds, are clear (are their theoretical/propositional articulations rational), grounded upon readily apparent or focused perceptual affordances, guided by a comprehension of the personal teleologies of their intended audience (those features of existence which resonate most profoundly to that audience as conducive to flourishing), and supported by emotional histories and considerations that both compliment these other articulations of the intent as well as avoid the fault of emotional incongruity or inconsequence to one's intended audience.

3.0 EXPERIENCING INTENTIONAL FLOWS: JAZZ AS PROTO-INTERACTION DESIGN

Technology has nearly always been a part of performance. From the earliest uses of the technology of language to the seating structures carved into the hillsides of ancient Greek theaters to pageant wagons to gas lighting to the host of technologies routinely used in modern performance venues, history is full of examples where theatre and performance illustrate potential symbiosis between a new technology and the humans who use it.[183] If such instances of symbiosis exist throughout performance history, there are undoubtedly numerous other examples of a breakdown in symbiosis created through the introduction of new technologies into performance spaces. One could plausibly conduct an historical examination of the way that emerging technologies have negatively altered audience engagement at live performances and argue that current, prevailing cultural norms stipulating silence in the audience are more indebted to technological developments than they are to the nature of live performance. Arguably, unfettered use of emerging media by audiences today could effectively reflect the experiences of Elizabethan or classical Greek audiences in their raucous interactions with each other and their propensity to disrupt the performance on stage. Perhaps this vision is overly optimistic; the dystopian vision of a disinterested, distracted audience always hangs like a sword of Damocles over the technologically optimistic. Living comfortably

[183] Jennifer Waldron's work on Shakespeare's use of language as a technology has been immensely helpful in shaping my thought in this area. There is a growing body of work that examines the aesthetic and cognitive impact of performance technologies as they have developed historically. See for example, various case studies in Phillip B. Zarrilli et al., *Theatre Histories: An Introduction*, 2nd ed. (New York: Routledge, 2010) and Jennifer Waldron, "Dead Likenesses and Sex Machines: Shakespearean Media Theory," forthcoming in *A Handbook of Shakespeare, Gender, and Embodiment*, ed. Valerie Traub (Oxford University Press, 2014). I envision my dissertation as contributing to this domain of scholarship while drawing applications to developing rather than historical technologies and introducing work in the philosophy of action into this dialog.

beneath this sword requires a solid theoretical grounding and ample practical testing of ideas in the design of new technologies for time-honored traditions of performance.

I have argued in the prior chapter that, as a discipline, theatre and performance studies holds the potential to offer more to technological design than merely "incorporating" emerging technologies into performances—making them "part of the performance." Performance studies scholars and artists, as experts in contextualized human action, have practical knowledge essential to the design of ubiquitous computing as it is used within a physical (as opposed to virtual) environment, especially if that environment is a performance that is itself designed to elicit sustained contemplation on a work of art. In many ways, the study of live performance is an ideal space for discovering important keys to a human-computer symbiosis.

However, in my analysis I deployed a theory of action that relied on strongly structural relationships between actions to demonstrate the non-expressive but ecologically embedded nature of intentionality. Actions were said to be intentional if a certain form of the question "Why?" could be applied to them. Action ø can be linked to prior action ɵ by the answer to the "Why?" question that ø gives to ɵ. Alternately, ɵ supplies an answer to the question "How?" applied to ø. But these teleological structures of intention within action were conceptually shown to underdetermine the *meaning* of an action. That meaning arose, it was argued, out of a tightly interlocking and mutually constraining relationship between the intentionality of an action and the expression of an "expanded description" applied to it.

When thinking about live performance, and especially when attempting to achieve human-computer symbiosis by tracing the intentional flows of a performance into the design of a new technology, we cannot overlook the fact that the majority of performance artists, arguably, would emphasize the importance of the meaning of their performances—even if those performances are

thought to hold multiple, potentially ambiguous meanings. How performance conveys meaning is, in fact, the subject of a great deal of the academic scholarship surrounding live performance. Is a new technology that is designed to merely correspond with intentional flows in a performance while ignoring the meaning(s) of the artistic work sufficiently creating human-computer symbiosis? Because the propositional expression of intent was shown to be tightly intertwined with the streams of intentionality coursing through any sequence of actions, merely mapping intentional streams into the design of a new technology appears to be, at best, only half of the story of a live performance. What about the other half?

As it turns out, if in designing new technologies we attend carefully to the application of the intentional structures within the actions of live performance, the "other half" (or meaning) of the experience-cum-technology will begin to emerge within the design in rather surprising ways. While this emergent meaning may not parallel as closely as some would like the meanings derived from an experience-sans-technology, attending to the intentions within a performance can do a great deal of work toward bringing us closer to a human-computer symbiosis.

Because we as performance artists and scholars have a unique form of knowledge, we know how actions work. But the impact of artists on interaction design goes deeper than this. Beyond our skill in constructing flows of intentionality, when we begin to derive the intentional flows of action within a specific performance form and in turn map those intentional flows into the design of a new technology, we find that these same intentional flows are already designed to incite interaction among performers and audience members. Live performance can be conceptualized as placing living agents within an ecological niche comprised of both inanimate physical structures, other agents, and their actions in order to present potentials for action and interaction that display a symbiotic coupling of agent and world—agent and ecological niche. In effect, the design of live

performance is already a proto-interaction design, in so far as performance designers, directors and writers carefully select the ecology, prior intentional streams (the background story) and current intentional streams needed to present performers with potentials for action that build upon and complete these designed intentional, teleological structures of action. This in turn creates the particular ecological niche needed for reciprocity to form with other performing agents in the performance.

In this chapter, I will begin by examining some important considerations concerning the way that intentional structures are experienced by audiences as the beginning of a meaning-making process. This discussion will focus particularly on some of the work done within musicology on structuralism and functionalism, and will reveal some of the difficulties of attempting to "map" intentional flows, which occur within a particular ecological setting, onto the design of a new technology. This discussion will also examine the beginning of a solution to these problems derived from the phenomenology of active experience within a physical and social ecological niche. Intentional flows may display a distinct structure, but that structure is experienced through a dynamic feedback loop that arises as an agent explores the physical and social environment or ecology in which those intentional flows occur.

We have already seen the importance of the environment in which action occurs in determining the relationship between the intentionality and expanded description (or meanings) of an act. Similarly, when performers execute intentional action in performance, they do so within a uniquely designed environment or ecology—the performance art form. In the case of this dissertation, the art form to be examined is jazz music. Jazz provides particular parameters of performance that establish certain goals or "ends" for artists and specifies relationships by which those ends can be achieved. But jazz, importantly, does not over-specify ends and relationships,

which creates a situation in which musicians must actively monitor and negotiate a successful performance. Consequently, jazz is an art form that both creates and relies upon close agent-ecology coupling. It provides an ecological niche that both invites and relies upon artists simultaneously creating, experiencing and creating *by* experiencing intentional flows in action. Jazz is a *techne*, a skill, that enables and functions through interaction. As such it is proto-interaction design, but interaction design of a particular sort. In robotics and artificial intelligence, agent-ecology coupling has been termed passive-dynamic design.[184] In Chapter 4, I wish to argue that when we are designing technologies for use in live performance settings by tracing the intentional flows within that performance form into the technology design, we are engaging in dynamic-passive *interaction* design. The performing arts may, in fact, already be the highest expression of this type of design. In Chapter 4, I will use the analysis of jazz provided by this current chapter to model the dynamic-passive interaction design of the Nymbus platform for audience interaction.

3.1 IDENTIFYING INTENTIONAL FLOWS: METHODOLOGICAL PROBLEMS AND STRATEGIES

In the prior chapter I briefly discussed how Anscombe's theory of action avoids the slip into behaviorism. The meaning of an action is not solely derived from the teleological, intentional structure found in behavior. This is where motivation comes into play, which can result in a propositional *expression* of intention. However, in my project I risk running into a behaviorist

[184] Pfeifer, Bongard, and Grand, *How the Body Shapes the Way We Think: A New View of Intelligence*, 89–140; Clark, *Supersizing the Mind*, 1–29.

problem. With a design methodology based on identifying the flows of intention in a live performance, which are traced through the physical behaviors of agents interacting with their environment, the danger arises that performance will become reduced to behavior for the purposes of design.

Jacqueline B. de Jong in *Collective Talent: a Study of Improvisational Group Performance in Music* sums up the issue when she asks, "The implicit assumption that sound production and communication are related 'naturally' has to be questioned seriously. Are opportunities to communicate inherent to the use of sounds? Or are opportunities to communicate dependent on a selection of sounds and on the way in which these sounds are ordered?"[185] I have been making the case that the ordering of sound-making actions is highly important to the conveyance of meaning, but that ordering alone is insufficient for meaning to be conveyed. Ecological context and agent motivations are also integral to how actions convey meaning, in this case, actions that produce music. De Jong similarly affirms that although the traditional notation system (TNS) in Western music defines a great deal of the rules and constraints that should accompany a "proper" performance of a musical work, this notation system nonetheless leaves a great deal of leeway for interpretative expression by the musician.[186]

To be sure, the intentional structure of the live performance is not exhaustively transcribed into the score, which is itself a form of technological extension of music. Intention is found in the actions of the musician, which are not determined entirely by the musical score alone. Said differently, musical scores underdetermine the actions required for a correct performance of a musical work. But that is not quite the difficulty. Rather, because I am proposing a design method

[185] de Jong, *Collective Talent*, 28.
[186] Ibid., 29.

to be employed in the creation of a new technology for use by audiences, merely cueing them into the intentional structure of the music does not seem a robust enough approach to design. A performing musician adds "interpretative" elements to music notated on a score, and he presumably has some motivation for that addition of interpretative elements to the score. Since motivation is *not* part of the intentionality of an action (intentions underdetermine motivations, as was discussed in the prior chapter), music is much more than mere codified, structured intentionality. It invites interpretation by performers based on individual motivations. But how does music incite this type of interpretative input from a musician?

Even if we could reasonably limit our design methodology to the identification of intentional flows alone, the sheer quantity of those flows would quickly overwhelm our design objectives. Harris Berger in *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience* examines the difficulty of adequately capturing all the dimensions of the performance act. Berger traces the theoretical genesis of this difficulty to the ethnomusical and folklore debates dating to the 1960's.[187] He writes, "If the [ethnographic] text is a record of performance, and if the performance is the object of study, then, performance theory suggested, the text must expand to represent all the dimensions of the performative act."[188] Ethnomusicologists and folklorists subsequently began to investigate verbal arts and the kinesics of performance.[189] However, these new directions in ethnographic study nonetheless became an impressive catalog of behaviors while failing to provide the necessary examination of the ethnographer's selective process involved in

[187] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 4–5.
[188] Ibid., 5.
[189] Berger references for example, Tedlock, *Finding the Center: Narrative Poetry of the Zuñi Indians*; Bright, *A Karok Myth in "Measured Verse"*; Fine, *The Folklore Text: From Performance to Print*. among others.

transcribing those behaviors and the selective process of audiences experiencing those behaviors in performance. Berger argues:

> Elizabeth C. Fine's *The Folklore Text* (1984), for example, augmented verbal transcriptions with schematic representations of the gestures that accompanied the performance. While Fine's transcripts are highly suggestive, it is not clear which of the transcribed gestures are significant or what they might mean. Similarly it is not clear which if any of the gestures were intended [or "motivated" in Anscombe's action theoretic framework], when such [motivation] emerged, or with what detail. Such problems bring us full circle to the process of transcription. Without addressing the problem of [motivation] and significance, how does the transcribing scholar know what level of detail to notate?[190]

The experiences of audience members as well as performers constitute an important facet of the study of musical performance that is not captured by ethnographic attention to the behavior of musicians alone. Audiences and performers by virtue of their embodiment in the contextual space of music performance as well as in their active, selective listening habits and choices limit the value of mere "transcriptions" of the behaviors of music performance. Behavior choices of musicians during live performance, while important, are nonetheless constantly in a form of "non-verbal dialogue" with the selective attention of the audience.

3.1.1 Avoiding Structuralism: The Ecological Placement of a Listener within in a Musical Context.

Structuralist scholars within ethnomusicology attempted to overcome the problems associated with the selectivity of the listening ear in musical performance transcriptions by employing mechanical transcribers to capture what they took to be the "raw data" of performance.[191] At the heart of the

[190] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 5.

[191] Ibid., 9. As quintessential examples of this type of work, Berger references Seeger, "Toward a Universal Music Sound-Writing for Musicology"; List, "The Reliability of Transcription"; Reid, "Transcription in a New Mode."

structuralist approach is a concern with the deep organizational structure within music as the foundation upon which the significance of a musical performance becomes apparent.

My proposed design methodology might be construed as broadly structuralist. Given that I have focused on the teleological intentional structure of performance actions in an attempt to demonstrate the careful construction of a performance work, such an approach might be taken to indicate that these intentional structures are in fact the dominant means by which artists render their work meaningful. Indeed, in the prior discussion of mimesis, I attempted to follow Halliwell's intentionalist theory of Aristotelian mimesis in which the metaphysical ideas of artists are conveyed through their medium in the embedding of intentionality within that medium through the action of *shaping* the medium—the medium is imbued with structure or "form" in Aristotelian thought. Structuralism has had its critics since the late 1960's, and I would like to distance myself from the structuralist program. However, placing these problems aside for the time being in the hope that I can avoid structuralism in what follows, I will instead briefly examine what I take to be a decent example of a technology for music experience that demonstrates a structuralist approach to design: music visualization software. Visualization software is similar to the type of interactive platform that I wish to ultimately design, and it integrates significant structural components of music into its design. However, this reliance on musical structure alone is a design method that I wish to avoid. Studying how and why this software is designed will help clarify the solution to structuralism that I will propose in the remainder of this chapter.

Visualization of music has become commonly experienced in the visualization software incorporated into standard media players such as iTunes and Windows Media Player. Visualizers reached their peak of popularity in the mid to late 1990's, but still remain within cultural awareness today. They have served as the basis for experimental work in live digital visual

artistry.[192] Arguably the original music visualizer was the Atari Video Music console (1976), which provided users with a simple interface consisting of five knobs and twelve buttons. The console received audio input from a playback device. This audio input could be manipulated by left and right gain knobs. The adjusted audio input served as the informational basis for the generation of psychedelic visualizations, which the user could also manipulate through color and contour knobs as well as shape, orientation, and "presets" buttons.[193] While presenting the user with limited classes of interaction and relatively low-quality graphics, these few parameters of manipulation nonetheless gave users remarkable flexibility, allowed for real-time interactivity, and enabled the creation of unique visualizations for every playback of a single song.[194] Despite some popular applications of Atari's psychedelic visualizations, the Video Music console ultimately failed to gain wide adoption.

The visualizers that became popular in the 1990's provided higher quality visualizations, but did not afford users the degree of interactivity of Atari Video Music. Interactivity will become more important in the later stages of this chapter; I wish to focus on these more popular visualizers here. The visualizer G-Force, created by Andy O'Meara and released in early 2000, was subsequently licensed by both Apple and Windows and released with their media players, iTunes and Windows Media Player, respectively.[195]

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[192] Mailman, "Improvising Synesthesia: Comprovisation of Generative Graphics and Music." provides an excellent example.

[193] Wikipedia Contributors, "Atari Video Music"; Atari Historical Society, "Atari Video Music."

[194] For a demonstration of the Atari Music Video console and visualizations see *Atari Video Music Demonstration*.

[195] Kahney, "Music Artist Has Sinking Feeling"; Wikipedia Contributors, "Music Visualization."

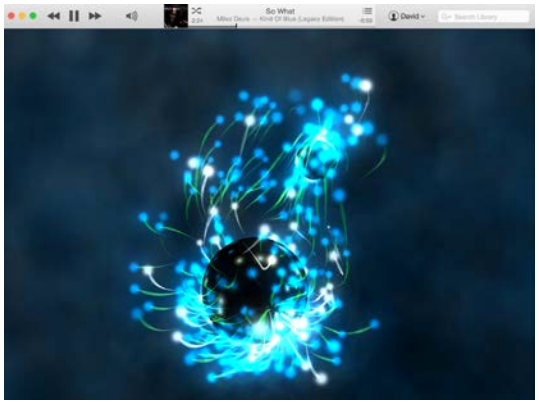

Figure 3.1: iTunes Visualizer

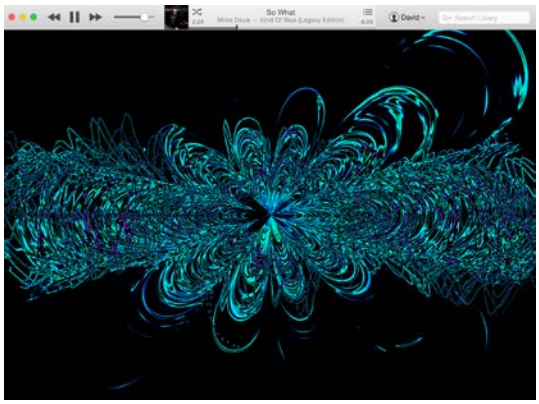

Figure 3.2: iTunes Classic Visualizer

At a very basic level, these visualizers operate by running an algorithm that draws a graphical image on the screen. Part of the shape is predefined, but other aspects of it are determined by a set of variables. The values of those variables are derived over time from the currently playing digital music track. For example, the colors of the visualizations might be determined by specific frequency ranges. In Fig. 1, the floating balls and points of light are constants of the image, but their size and number appear to the user to be linked to musical elements derived from the audio track. In Fig. 2, the shape of the image follows (with significant distortion) the sinusoidal waveform that is derived from a Fast Fourier Transform (FFT) of the audio stream.[196]

As a visual correlate to the aural experience of music, the limitations of these visualizers become readily apparent. The music is itself a digitization of (frequently) analogue performances, and the rapid but nonetheless "sampling" process of digitization has repeatedly been identified as a key difference between analogue and digital recordings. For the purpose of visualization, digital music data is again sampled when the audio wave is processed with FFT. Additionally, frequency based visualization does not recognize musical rhythm or tempo unless beat detection algorithms are used, which have limited capability and accuracy. While the FFT method generates

[196] Kooheji et al., "Creating Music Visualizer."

frequencies, actual musical tones that are easily detected by the listening ear are difficult to extract from these frequencies.[197] We can therefore see that these visualizers greatly diminish the complexity of music through repeated sampling and transformation into digital data that can is suitable for automatic, computational analysis.

The limitations of music visualizers pertain particularly to the decomposition and visualization of music into identifiable tones, pitches, rhythms, tempos, melodic contours, timbres, etc. and the extraction of musical relations between those musical features. Currently, extensive work is being conducted both theorizing and creating new systems and programs for music visualization that attempts to overcome many of these "deficiencies" in music visualization.[198] Many of the more sophisticated visualizers overcome the limitations of music data conversion with FFT by receiving MIDI input directly from the musical instruments.[199] For example, MIDI can capture information about the dynamics with which a keyboardist strikes the keys. As such, MIDI conveys a greater degree of musical data that is useful in the training of music students. From the standpoint of action theory, we can say that these programs give the student a synesthetic experience of the intentional structure of action at work in the production of the music. FFT based visualizers only provide some interesting accompaniment to the experience of music as is

[197] There are some software programs on the market that perform this more detailed frequency analysis. I do not know their level of accuracy. For example, see Sibelius, "Sibelius | AudioScore Ultimate 7 Polyphonic Music Recognition & Transcription."

[198] Ethan Hein, a musicologist at NYU's Music Experience Design Lab has provided a helpful introductory list of some of these systems and programs. Hein, "Visualizing Music."

[199] MIDI is the acronym of Musical Instrument Digital Interface, which is a technical standard developed 1983 and is maintained by the MIDI Manufactures Association. The protocol contains 16 channels with each channel transporting messages composed of 128 pieces of information. Since MIDI signals are generated by musical instruments, much of the data of performance is comprised in the way that the signal is created and sequenced; the channels and message values allows for the MIDI signal to further convey facets of musical performance such as "velocity" of instrument actuation and pitch.

evidenced by their widespread (if not somewhat short-lived) enthusiastic reception. As a heuristic focus on the actions that create the music, MIDI projects have significant merit.

However, the vast majority of musical audiences do not have aspirations to become musically accomplished while listening to music; a new technology designed for the listening audience should not attempt the heuristic task of conveying the minutia of musical structure. At least, that should not be its primary objective. While research has shown that expertise in one of the performing arts contributes to a greater degree of awareness when observing that particular art form in performance, we can safely assume that most audiences would be overwhelmed by a comprehensive representation in any form of the complex intentional structure in the actions of performers.[200] They might delight in the expert performer's description of the concert, with explanation of why certain musical elements stand out and others provide a helpful background of experience, but this would hardly be an adequate substitute for each audience member's *own* experience at the concert. These observations are relatively trivial. What is not so trivial is what role, if any, intentional flows in performance action *should* play in the design of new technologies for audiences.

Is it a matter of selection and degree: selecting and conveying the right intentional flows in the right quantity? The problem with this type of design program lies in its normative demands—how should we determine what counts as the "right" flows and the "right" degree. These two problems are most likely related. In the prior analysis of action, it was shown that the teleological structure of action displays a nested hierarchy of intentions. One action is done for the sake of another, which is done for the sake of yet another. Each subsequent action explains and to some extent is comprised of the actions that precede it. One builds a house by stacking bricks; house

200 Cf. Decety and Grèzes, "The Power of Simulation: Imagining One's Own and Other's Behavior."

building is the explanation of the mason's work. One plays a note *in order* to play a measure *in order* to play a bar *in order to* play a phrase *in order* to play an improvisation. At what level of abstraction should these levels of intentionality be mapped into the mobile device user aesthetic experience? Intentional flows in their purely structural form should not be overlooked, but merely identifying these structures is insufficient to determine their use in design.

A way forward is indicated in the history of ethnomusicology. The structuralist use of mechanical transcribers eventually became subject to the criticism that such an approach overlooks both the fact that a listener's ear and body affect the experience of a performance and the fact that transcribers do not render purely objective transcriptions.[201] As Berger asks,

> Is the music a physical object, existing independent of any person (composer, musician, listener) and capable[202] of being fully described by an objective transcriber? Is the music the research participant's intention? Is the music the performance? If the music is an independent object, how can we account for features of the sound that are constructed by the listening subject, such as the underlying sense of pulse? …Without a spatiotemporally specific subject engaged with sound waves, there is no now, no before and no after, no loud or soft, no accent (just changes in amplitude), and no underlying pulse. It takes a subject—always an agent and always social—to hear a period of sound as linked together in a phrase, to hear a phrase as present or past, to stand close to or far from a sound source, to constitute a pulse.

In *This is Your Brain on Music*, Daniel Levitin's arguments concur with Berger's emphasis on the personal perspective of the listening subject. Levitin identifies some of the basic "building blocks" of music: loudness, pitch, contour, duration (or rhythm), tempo, timbre, spatial location, and reverberation.[203] Of these musical building blocks, he states that pitch is a purely psychological construct derived in part from the actual frequency of a tone and its position relative to the musical scale. Loudness is likewise a psychological construct that holds a non-linear relation to the physical

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[201] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 9.
[202] Ibid.
[203] Levitin, *This Is Your Brain on Music*, 14–15.

amplitude of a tone. Spatial location and reverberation are products of the embodied listener within a certain environment. These elements of music are individually separable, according to Levitin, but the difference between music and random noise is that these elements combine to form relationships that "…give rise to higher-order concepts such as meter, key, melody, and harmony."[204]

We would hardly want to draw a distinct line between these higher-level concepts and the lower level musical elements from which they are derived just as we would hardly separate the home from the bricks that make it up. The action theory defended in this thesis argues that we see in a house a potential for further action, namely entering and dwelling. Similarly, marimba bars and mallets present potentials for striking; tonal relations present potentials for harmonic and melodic constructions. A great deal of the perception of potentials for action arises out of morphological complimentarily between the two components: marimba bars and mallets, harmonic and melodic pitches.

In the musical experience of audiences at a live performance, we must look beyond mere musical structure and place experience within the broader horizon of potentials for action for individual subject—identifying what the action is good for, its "end" as expressed in an expanded description of the act. Identifying this end is in large part a function of subjective perspective. Attentional focus among audience members is a key aspect to this subjective perspective. But the structural elements of music are also key to this personal perspective as listeners actively place structural elements with their personal social and cultural environment. If it takes a subjective agent to hear a phrase in a period of sound and to hear that phrase as past or present, it also takes a social agent to ascertain the full expressive potential of those sounds. Berger states that

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[204] Ibid., 16.

> …if these basic, 'objective' aspects of the sound imply a listening subject, the affective and more complex formal dimensions do this all the more. Before the designation of any musical feature as an objective sonic fact or a subjective mental construct is our pre-reflective engagement with the world, our immediate experience of music. If we think of our study object as experiences actively and social constituted by perceptual subjects, then spectrograms, interview data on musical [motivations], and ethnographic descriptions of performance can be understood as different moments in the project of transcription.[205]

As an ethnographer, Berger is interested in these various moments in the project of ethnomusicological transcription for their influence on the meaning-making process of live music creation and reception. But when considered for the purpose of design of a new technology for reception, the specific meanings derived from a musical piece are not as important as how that meaning is made. Reception occurs in an active, listening subject, in the context of identifiable structural musical relationships, and within a specific physical and social and cultural ecology. In effect, music is a highly fluid medium that can be used for nearly infinite expressive purposes. Consequently, our design of a new technology should aim at a malleable platform that is capable of mapping certain intentional flows at a variety of differing levels—at a low level of behavior; at the level of musical structures such as rhythm, groove, and melody; and finally at the level of expanded descriptions of intentional flows referencing ensemble dynamics, musical reference and the like. A technology that can map low-level intentional structures in behavior sequences should also be malleable enough to server the expressive purposes of the artist.

In this section I have merely attempted to argue that the intentional flows that must be mapped into technology design cannot be limited to low-level musical structure alone. These structural components are received by a subject within a particular physical and social ecology. Later in this chapter, I wish to propose an action-based design method that takes into account the complexities of subjective perceptual agency within specific physical and social ecologies.

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[205] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 9–10.

However, social and physical ecologies can also be over-emphasized, leading to a functionalist conception of music experience. I will examine this danger in the next section.

3.1.2 Functionalism: Social Function and Active Practice

Following a Darwinian model that viewed the individual in a process of recursive evolutionary adaptation, functionalism began to influence a variety of the human sciences in the final two decades of the nineteenth century. Phenomena were explained in terms of their purported function in promoting the organism's survival.[206] As evolutionary theory developed further, the functionalists of the 1920's rejected this early functionalism, which was seen to promote an essentialist human nature, and began to emphasize the importance of social cohesion and organization to maintain evolutionary dominance. With some notable exceptions, these new functionalists began to view individuals as derivatives of social organization, deemphasizing individual personality and action.[207]

Originally a theory dominant in anthropology and sociology, functionalism began to influence ethnomusicology in the late 1930's with a watershed publication arising in Alan Merriam's *Anthropology of Music.*[208] Merriam urged ethnomusicologists to begin assessing musical affect, form, and meaning as a product of culturally specific social activity.[209] Despite this decided move away from earlier Darwinian models that led to conceptions of universal meaning in musical form, Berger points out that the functionalism propounded by Merriam and his

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[206] Kuklick, "Functionalism."
[207] Ibid.
[208] Merriam, *The Anthropology of Music*; Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 10.
[209] Ibid., 10.

contemporaries mistakenly emphasized high-level social phenomena, overlooking the agency of the individual's reception of low-level musical structure. Their system similarly displaced musical structure with cultural context as the explanation of musical affect.[210] While functionalism rightly identifies the impact of high-level social phenomena on cultural experience, it overextends the explanatory power of social phenomenal to the perception of musical structure and affect. These aspects of musical experience are more properly evoked and explained in the granular, low-level analysis discovered in the *active practice* of both performance and perception. Berger writes:

> Within ethnomusicology, we can use the notion of practice to gain insights into both the problem of music and affect and the relationship between musical activity and large-scale social context. On the 'microlevel,' musical structure and affective content are constituted in the practice of perception. As a kind of practice, this musical perception is both deeply informed by the practitioner's situated and broader social contexts and actively achieved by the subject. On the 'macrolevel,' the historical emergence of relatively stable forms of the social life of music (performance events, musical cultures, and subcultures) are indeed informed by functionalism's 'larger social contexts.' Social 'context,' however, is not an anonymous force separate from individual human conduct; rather, it is made up of the intentional and unintentional consequences of past practices.[211]

Berger, following Anthony Giddens' theory of strucutration, argues that practice is foundational to the experience of music both in its basis of sound production as well as in the elemental decomposition of social function. Consequently, neither the low-level, structural relations of music nor the high-level social phenomena can solely account for the complexity of musical production and experience. Both operate reciprocally to affect musical production and experience by audiences. Giddens' approach is interesting, but Husserlian phenomenology will help model the reciprocity between low-level sonic structure and high-level social function in a way that has significant resonance with the model of intentionality in action already defended.

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[210] Ibid.
[211] Berger, 1999, 10-11.

3.1.3 Phenomenology and Active Experiencing

According to Husserl, perceptual experience is constituted in three distinct phases. First, perception arises in a subject as the material object of experience impinges upon sensory receptors; material interactions create sensory data through perspectival variation—what Husserl called the *hyle* of experience.[212] This experience of *hyle* is known as the "Material Phase of Experience."[213] For example, an audience member at a jazz concert sits, stands, or perhaps dances in a manner that is spatially, optically and aurally relevant to her experience. She may see some band members better than others, hear some instruments better or worse than others, observe facial expression and posture in various ways, and perceive other audience members with a greater or lesser degree of frequency and detail. The material phase of experience provides us with features of objects and the perceptual boundary conditions of the experience, which are theoretically if not actually shared with other people or shared between the perspectival variations of a single person through time. For example, I see a particular foot-tapping pattern of a bass player and notice how this rhythm is syncopated to the rhythm he is currently thumping on the side of the bass. My wife cannot see the bassist's foot tapping, until she leans into my perspective. As she does so, I notice that the pianist's left hand is emphasizing the same rhythmic pattern as the bassist's foot-tapping. These two experiences, demonstrate the shared nature of the material phase across time and space; my perception of the bassist's foot-tapping is shared in my later experience of the pianist, and my particular visual vantage point is shared with my wife.[214]

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[212] Husserl, *Ideas for a Pure Phenomenology and Phenomenological Philosophy*.
[213] Follesdal, "'Brentano and Husserl on Intentional Objects' by Dagfinn Follesdal," 40.
[214] Ibid.

According to philosopher Dagfinn Follesdal, whereas the material phase of experience presents us with spatial and partial temporal boundary conditions of experience, we can operate upon the *hyle* of experience in an imaginative manipulation of them that is in a sense neither temporally nor spatially bounded.[215] This operation upon experiential *hyle* is what Husserl called the "Intentional Phase of Experience" or *noesis*, and is a process in which the form of the object of experience begins to emerge from the material phase of experience.[216] This roughly correlates to what Anscombe identified in her argument that practical knowledge is the "cause of what it understands."[217] Frederick Stoutland points out that many philosophers overlook the fact at Anscombe is here referring to formal causality.[218] Formal causality will receive greater examination and importance in the next chapter, but for now the important thing to see is that this meaning-making process of identifying the form within the *hyle* of experience can happen in a variety of ways as determined by our particular relation to the form that we ascertain.

If we are viewing another person's actions, say the behaviors of musicians on stage, we can ascertain the formal relations between the actions and come to some understanding of what those actions are "good for"—their end within the teleological structure of action that they comprise. If we are observing the *hyle* of, for example, a drum or a trumpet, then we can begin to ascertain what it is good for, or the potentials for action that it presents to us for experience, perhaps anticipation of a subsequent musical phrase or rhythmic riff. Anscombe argued that some of these formal components of experience are apparent in the spatiotemporal aspects of experience (the *hyle*); other formal components extend beyond the spatiotemporal experience and are arrived at

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[215] Ibid., 41.
[216] Ibid.
[217] Anscombe, *Intention*, 82.
[218] Stoutland, "Introduction," 29. The Aristotelian four causes will be revisited later in this chapter.

through an "expanded description" of the actions, potential or actual, that we experience (the *noesis*).[219]

Importantly, the emergence of *noesis* in experience is not solely derived from a "purely mental" ascertaining of form implicit within the material phase of experience. Rather, *noesis* occurs through a reciprocal "feedback loop" of *hyle* and *noesis*. As an audience member enters a performance space, she sensorially receives the *hyle* of material experiences and perceives various potentials for action—she can move about the performance space, for example. Her *noetic* process will change as she gains more diverse experiences of *hyle* that are inconsistent with her original noetic hypothesis. A particular aisle, it turns out, did not lead all the way to the front of the stage. This updating of noetic assessment can in turn affect her perceptual attention to elements of her material experience. A sense of self-consciousness arises as the audience member contemplates whether to retreat from the dead-end or casually take a seat a little further back from the front of the stage than she had desired. Assessing these potentials, she begins to turn around and notices a friend seated slightly to the left. Delighted by the sight of her friend, she might think "Ah! This evening is shaping up nicely." She could describe the evening in a number of ways, but "shaping" is particularly appropriate given its connotation of the "form" the evening is taking through her experience and perceived potentials for future action. The presence of her friend presents material *hyle* of experience that inform the *noesis* of her experience.

Berger argues that by virtue of its emphasis on the active participation of subjects in constituting their experiences, phenomenology provides a middle ground between structuralism and functionalism. He writes,

> …perception is not infinitely malleable. I cannot see the map of Connecticut in Rubin's Goblet and call my experience a percept. However, the objectivity and autonomy inherent

[219] To my knowledge, Anscombe herself does not claim this similarity to Husserl; it is my own.

> in our experiences of the world should not blind us to the fact that those experiences are always had by a subject…This dialectic of the subject and the world is basic to all forms of phenomenology. Perceptual phenomena emerge as the outcome of the subject's active and meaningful engagement with the world.[220]

This active, meaningful engagement is the *noetic* moment for subjects engaged with the *hyle* of experience. *Noesis* occurs in the "expanded description" of the experience as it references traces of intentionality in the perceptual experience of agents as well as ascertains outcomes of future actions.

But this reciprocity between self and the world also occurs in a world comprised of other agents. Experience is therefore always social. Berger points out that "…built into my experience of physical objects is an awareness that objects posses features that are beyond my immediate grasp but may become the focus of future experiences. Pointing toward a world beyond the immediate givens, present experience entails the existence of other subjects." Philosophy of action can add to this observation that even within our immediate perception of physical objects, the teleological structure of action implicit within those objects can reveal the subjective agents responsible for their existence. Houses do not build themselves; the intentional structure of brick stacking is left in a brick wall, indicating a brick-stacker. Husserl also argued that to experience the world is to experience it as a body in the world, which is itself an object for the experience of others.[221] Finally, our actions are directly situated within social contexts, seek social ends, and hold the potential for foreseen and unforeseen social consequences.[222] If an audience member's experience of the flows of intentionality cannot be abstracted from the material ecology within which they occur, neither can they be abstracted from the particular social ecology. Berger asserts

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[220] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 20–21.
[221] Ibid., 21; Husserl, *Cartesian Meditations*, 103–128.
[222] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 21.

that “The constitution of musical phenomena is actively achieved social practice, powerfully informed by the situation, the participants' goals in the event, and a potentially endless range of larger cultural contexts….”[223]

These phenomenological observations point to the fact that cultural phenomena are not reducible to the intentional flows present within cultural artifacts created by artists. When designing a new technology for an existing art form, designers must take into account more than merely the intentional flows that went into making the art, which are the traces of action left embedded within artifacts and performances by artists (perceived as *hyle* that give rise to *noesis*). Designers must also consider the experiential component of the audience for whom the artifact was created. Phenomenological thought considers not only the ecological context, the event horizon, in which the experience of art occurs, but also the active process of experiencing engaged in by cultural participants. However, as Berger rightly points out, the “range of larger cultural contexts” is potentially (or rather “practically” for designers) endless.

The significance of this observation does not lie in its apparent affirmation of the relativity of experience. Nor does it result in an argument against a technological compliment to the experience of art that derives its principals of design from that art form. The immense diversity of experiences among audience members should in no way dissuade us from designing a technology for audiences based on the intentional flows embedded within the art form.

Instead, this diversity of experience should alert us to the unique nature of artistic practice and the demands that this practice place on a design methodology based upon it. Given the broad range of cultural exposure, the unique event horizons among cultural participants, we should be shocked at the success of any collaborative live performance—especially a collaboration engaged

[223] Ibid., 23.

in real-time such as jazz improvisation. If perceptual function entails an active feed-back loop of the *hyle* of experience through selective attention by the perceiver and the formation of *noetic* comprehension of what is perceived, how could anything as sophisticated as improvisation among diverse members of an ensemble come about? Likewise, the impact of experiential diversity among audiences will impact a design methodology based on intentional flows within performance. Despite the predominantly static, sedentary behavioral patterns of our contemporary audiences, live performance art is more than the presentation of carefully constructed flows of intentionality. Rather performance entails the *purposeful presentation* of these flows to an audience. Because audiences experience intentional flows through an active process of selective attention within a shared physical ecology and partially unique social, ecological niche, their experience is *underdetermined* by intentional flows alone. This has certain ramifications for designers who wish to model their creative practice on the practice of makers in the arts.

First, designers must not merely map intentional flows from the techne of the artist to their own technology, they must also observe those flows within the ecological niche created by a live performance and lend particular attention to the structural components of these intentional flows as they generate potentials for further action, what J.J. Gibson has called "affordances."[224] By observing the creative practice of performance artists, designers of new and emerging technologies should not observe that practice solely in isolation from the potential for interaction with audiences. On the contrary, a crucial component of that artistic practice lies in its unique design as a presentation *to* and a space for interactivity *with* an audience. They must seek to understand specifically how this happens in the particular art form. What is it about the creation of intentional flows in live performance that presents potentials for interactivity to the audience?

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[224] Gibson, *The Ecological Approach to Visual Perception*.

Second, designers should seek to *underdetermine* the experience of the audience by providing them with potentials for action and interactivity that centrally rely on their own engaged noetic capacities to constitute their own experience. This will in effect limit the extent to which the technology "constitutes" the subject and instead leave the subject in greater control of her own self-constitution. Rather than narrowing the experience of audiences, designers should see their role as merely extending the ecology of the performance. Given the limitations of technology and the current task oriented focus of much design, extending an existing ecological niche is an immensely difficult thing to do effectively.

Jazz provides an ideal illustration of these design principals and model for the creation of interactivity. By its improvisational nature, jazz invites interaction not only among performers but also between the audience and performers and among audience members. By design, jazz invites participation; as such it provides an excellent space for exploring the design of interactivity and performing arts-based interaction design for ubiquitous computing. In the remainder of this chapter, I will outline the basic structural elements of jazz and then trace the dynamics of interaction of the ensemble in and around intentional flows. I will end with an examination of how a musician's improvisational experience within this structural and social context places them as a dynamic observer and participant, which positions them as an ideal model for interaction design in the live performance context.

3.2 JAZZ AND INTENTIONAL FLOWS: DESIGNED FOR INTERACTIONS

Intentional flows within jazz music happen within the context of a specific song, in a specific time and place because they are produced by individual musicians. We cannot generalize from a single

performance to an entire art form when it comes to intentional flows. On the other hand, art forms cannot exist apart from intentional flows. A finely granular approach to identifying intentionality for the purposes of design is, as has been argued above, both necessary and, ironically, impractical. Technologies for use by audiences must be creative platforms that are flexible enough to server the diverse intentional flows found from song to song, from concert to concert, from city to city, from time to time, around the world. However, I have also argued that intentional flows also operate at far less granular levels. If houses are built brick-by-brick, they are also built wall-by-wall and room-by-room. Just as we experience houses as buildings with doors and rooms suitable for entering and dwelling, we experience music at varying degrees of granularity. Creating a performance technology platform, therefore, requires that we identify effective levels of granularity of intentionality within jazz music in performance. In this section of this chapter, I will look at how experience of varying degrees of intentionally occurs for musicians in jazz performance. The emergent levels of importance within intentional flows in a musician's experience will serve as the model for my own use of intentional flows in design.

With over one hundred years of performance history and musical development that includes over fifty distinct genres, and as many distinct styles of play as there have been jazz musicians, it is difficult to identify the correct commonalities among genres upon which to base technology design.[225] Even legendary jazz musicians have had difficulty defining the musical form. Louis Armstrong famously said that "If you have to ask what jazz is, you'll never know."[226] Richard J. Lawn points out that jazz an "ever-changing style of music" that is evolving with

[225] Wikipedia Contributors, "List of Jazz Genres"; Berendt and Huesmann have constructed a fascinating genealogical timeline of the differing styles of jazz in relation to the blues. They only include 28 distinct styles; I imagine for clarity's sake. Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 3.

[226] Berendt and Huesmann, 2009, 664.

popular culture.[227] Despite this formidable challenge to classification, musicologists have nonetheless identified the broad contours of what "counts" as jazz—the high-level view of intentional flows constant across various musical styles. In this section, I will briefly outline what others have identified as the most salient, defining features of small ensemble, tonal jazz. Despite the oversimplification of a complex art form, these observations will provide a healthy start to identifying the primary, practically relevant intentional flows within jazz and how they are ordered in the experience of performing musicians.

Many writers have observed that jazz has from its earliest roots valued live performance over scored compositions. One primary reason for this value priority arises out of the intensely improvisational nature of the jazz performer over the carefully arranged and finally inscribed score of the composer. However, jazz improvisation occurs within a set of clearly defined parameters that have evolved to become "standard" in a relevant sense. Instrumentation is a good example of this standardization. For example, the earliest form of jazz originated in New Orleans where the ensemble was made up of trumpet, clarinet, trombone, bass, and drums. Thus, a jazz band can be divided between a "front line" (trumpet, clarinet, trombone) and a rhythm section (bass and drums).[228] Of course, jazz history is marked by well-known, large bands that included other sections (e.g. vocalists and strings) and a bandleader, but this basic structure is very common and foundational to the musical form.

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[227] Lawn, *Experiencing Jazz*, 8.

[228] The Chicago school that emerged in the 1920's added the saxophone to the front line (1923) and the piano, guitar, and frequently the banjo to the rhythm section.

3.2.1 Rhythm

Rhythmic complexity was one of the first truly defining features of jazz. The lead in the hierarchy of rhythmic instruments, usually the drums, establishes a steady pulse (colloquially "beat" and technically "tactus"). The beat is the natural place for foot-tapping and is linked to tempo or the speed at which songs are played. In *This is Your Brain on Music*, Daniel Levitin explains the remarkable capacity of the human brain to remember the tempo of songs with surprising accuracy. It only takes a variation in tempo of just over 4 percent for most people to detect the variation from the norm. A song usually played at 100 beats-per-minute (bpm) must remain within the 96 to 104 bpm range in order to sound right to most listeners. Drummers naturally have a much finer sense of variation.[229]

Meter is established when certain beats are emphasized in a recurring pattern. For example, most western music emphasizes the first and third beat within a four-beat measure with a slightly lesser emphasis on the third beat (ONE, two, THREE, four; ONE, two, THREE, four…). Additionally, the musical notes that accompany the beat can be long or short in duration; each note being sustained for a fraction of a beat, a single beat or for several beats. This patterning of various lengths of notes forms the rhythm of the piece. In jazz, the drummer is the musician primarily tasked with time-keeping in a piece. The other rhythmic instruments work within this structure often embellishing the structure by playing just in front of or just behind the beat. The latter style is called "laying back" and can become a distinctive stylistic choice of a band.[230] Given our natural capacity for highly precise cognitive time-keeping, laying back or rushing in front of the beat can

[229] Levitin, *This Is Your Brain on Music*, 59.
[230] Lawn, *Experiencing Jazz*, 16.

have a subtle and powerful impact on our perception of what the musicians are doing—their intentions.

Syncopation occurs in a variety of musical forms, but is frequently deemed synonymous with jazz.[231] In European music, syncopation occurs when emphasis is given to the portions of the rhythmic sequence that lie between the beats; accenting the "&" in "1 & 2 & 3 & 4…." However, in jazz clearly defined syncopation between beats is exchanged for a greater degree of flexibility that allows the musician to create dynamic rhythmic complexity. Berendt and Huesmann explain that, "In jazz the displacements of accent are freer, more flexible, and more subtle. The accent can now be anywhere between two beats— precisely where the musician feels it is 'due.' This accent moves away from the beat but simultaneously stresses it, so it is termed 'off-beat.'"[232]

Similar to syncopation, the uses of polyrhythms, the simultaneous layering of multiple differing rhythms on top of a single foundational rhythm, has become a recurrent feature of jazz.[233] While syncopation operates within the context of a defined rhythmic structure, polyrhythm occurs as two distinct rhythmic patterns are intertwined. I will not attempt a more sophisticated, technically correct elaboration upon syncopation and polyrhythm, but I hope that these short descriptions of the musical devices each reveal a distinct intentional stream at work in its own creation. The base rhythm presents one intentional stream; syncopation upon the base rhythm presents another intentional stream that is created in relation to the base; the polyrhythmic additional rhythm presents a third stream, again set in relation to both intentional streams. From these intertwining of rhythmic streams, two more features of rhythm arise: swing and groove.

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[231] Syncopation, for example, is an important link between contemporary EDM Dance Music and Jazz and is one of the most important features of Dance Music. See Snoman, *Dance Music Manual: Tools, Toys, and Techniques*, 47..

[232] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 239.

[233] Lawn, *Experiencing Jazz*, 16.

3.2.2 Swing

Swing has been frequently referenced as the essentially defining feature of jazz. Yet swing is notoriously difficult to define. It was identified in the earliest forms of Dixieland and New Orleans jazz, and as subsequent jazz genres developed, they were often criticized because of their perceived lack of swing. Bebop, for example, arose in the 1940's and was first thought to lack swing, but later it was considered to have an even greater degree of swing than Dixieland and New Orleans jazz. Berendt and Huesmann argue that it took audiences some time to become sufficiently familiar with the new rhythms of bebop in order to identify the swing of the music in the standard rhythmic sections.[234]

Generally, swing is the driving, forward momentum of jazz that is perceived as the result of syncopation on the beat. However, swing cannot be so easily reduced to a set of transcribable relations between various elements of rhythm. Instead, it arises out of a particular free individuality of the performing musician as she identifies the right moment of accentuation within the context of the natural rhythm of the song in relation to the song's melody (particularly, the melodic "harmonic rhythm" of chord changes to be discussed shortly). Swing is therefore a product of individual choice; it does not rely on ensemble synergy, should be a feature of all jazz musicians, and may arguably occur without an ensemble at all. Berendt and Huesmann claim, "A jazz musician who does not swing—all alone and without any rhythm section—is no jazz musician. Thus the considered opinion of many modern musicians that it is almost as possible to swing without a drummer as with one…."[235]

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[234] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 235.
[235] Ibid., 239

Part of swing's resistance to transcription as been explained in terms of the difference between ontological and psychological time.[236] The former is roughly clock time or the ideal, regular segmentation of temporal existence. The latter refers to our perception of the passing of time, which is notoriously irregular and subject to lived experience and attentional focus. Swing, rather than arising out of ideal relations between features of musical rhythm alone, places those ideal rhythms of ontological time in relation and contrast to their psychological experience of the musical flow. As mentioned above, humans are capable of incredibly precise rhythmic perception and memory. However, within the context of musical performance ideally and precisely segmented by ontological time, we cannot overlook the importance of psychological time as musicians perceive a rhythmic and melodic structure and respond accordingly. It is a musician's rhythmic decisions that are made in reference to psychological perceptions of time within a musical phrase that gives rise to the forward momentum of swing. It is a perceptual result of non-propositional, practical knowledge, which is why it remains intractably resistant to propositional description. As jazz drummer Jo Jones said, "It's a real simple thing, but there are some things you can't describe, some things that never have been described…The best way you can say what swinging is, is you either play with a feeling or you don't. It's just like the difference between receiving a genuine handshake or a fishy one."[237]

[236] Ibid., 240.
[237] Quoted in Ibid., 237.

3.2.3 Groove

If swing arises through dynamic, *individual* interpolation of accent and emphasis in and around a regular rhythmic and melodic structure, groove occurs through a player's dialogue with an "other." Usually this "other" is the ensemble *community*, particularly the musical relationships established among the members of the rhythm section, however the dialogue of groove can also occur in the performance of an unaccompanied soloist. As Berendt and Huesmann argue that this occurs through the interactive "communication" (or I might argue "entrainment") of "…the breath, the limbs, the brain, etc…."[238]

Within the literature, groove has been used to refer to two facets of a jazz ensemble's playing. Either it denotes a structured pattern of accents created by a variety of instrumental timbres in relation to a time signature, or it refers to a particular energy and drive that arises out of fluid communication between members of the ensemble.[239] Berger attempts to limit his discussion of groove to the former, structurally defined aspects of the phenomenon. He claims that, "The essential feature of most jazz grooves…are the accents on beats 2 and 4 and the feel of swung eighths."[240] He then explains that, as was argued above, the regularity of the "swung eighths" are varied to the particular tune, genre, harmonics of the chord changes, and historical period of jazz.

However, I suspect that as Berendt and Huesmann claim, the two aspects of groove cannot be easily separated; they are differing, mutually supporting aspects of a single phenomenon.[241] First, the rhythm section within the ensemble has the *goal* of attaining tight structural synchronicity

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[238] Ibid., 243.
[239] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 98.
[240] Ibid.
[241] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 241.

in a variety of timbres, accents, rhythms and syncopations on a common beat. As this structure emerges within the rhythm section, the focus and energy of the ensemble increases, which in turn contributes to the tightness of their performance. Of course, the groove is usually a tacit objective of the ensemble, but it may actually arise at any moment in the feedback loop. It is driven by action and perception of action, but it can arise with either the focused attention in perception *or* the active, tight patterning of rhythms. Both aspects are mutually affirming and community building. All members of an ensemble may contribute to and participate in the groove, but because it is created through interactions among rhythmic elements of a song, those instruments capable of the greatest rhythmic emphasis and elaboration stand at the heart of the groove. It is usually a facet of interaction between the drummer and bassist, and like all interaction among human agents, paradigmatic examples have arisen throughout history.[242] The groove established by the rhythm section in its "rhythmic uniformity and micro-rhythmic deviation" is taken up by the rest of the ensemble and becomes in a very important component to their communal center and cohesion.[243]

3.2.4 Melody, Harmony and The Head as the Basis for Improvisation

Melody is usually the most easily identifiable and memorable component to jazz. Rather than attempt a detailed analysis of melody, I will rather summarize a few key points made by Lawn.[244] First, melody is usually conceptualized as linear, temporal and horizontal. It is defined by its development over time, which contributes to the sense of "texture" discussed below. Second, while

[242] Berendt and Huesmann cite for example, "…in the John Coltrane Quartet, Jimmy Garrison and Elvin Jones had this transcendent surefootedness, as did Tony Williams and Ron Carter with Miles Davis, Jaco Pastorius and Peter Erskine with Weather Report, Palle Danielsson and Jon Christensen with Jan Garbarek." Ibid., 242.

[243] Ibid., 242–243.

[244] Lawn, *Experiencing Jazz*, 18–19.

we often think of a song's melody as a whole and speak of it as the "tune," melody can be decomposed into distinct phrases. Often these phrases can be clearly picked out by non-musician listeners, but not always. Short musical phrases are grouped together to form larger segments of the tune (verses, bridges, etc.). These melodic elements may then be arranged and repeated to form the entire song. This gives rise to the song "form" to be discussed more below. Third, lyrics and tunes go together, both in their complementary composition and in mutual contribution to memorability. We remember lyrics by putting them to music; we remember our place in the melody by reference to lyrics.

Melody lines can be created through a progression of individual notes, which presents the listener with a very simple sonic texture. This single-note texture is *monophonic*. However, usually musical textures in jazz are much more complex; the melodic line is set against an arrangement of harmonies created through a background of chord progressions played by the chordal instruments, usually guitar and piano. Chords, by definition are harmonic sets of two or more notes usually played simultaneously.[245] Melody-plus-chord-accompaniment is *homophonic* music. *Polyphony* occurs when a second melody is intertwined with the first melodic line.[246] While polyphony is important to jazz, I will focus on the textural homophony of melody + chord interactions. It is of particular interest in jazz performance because of the way that it facilitates improvisation by both soloists and accompanists.

Melody is conceptualized as a horizontal, linear flow of notes, chords, on the other hand, are conceptualized as stacked sets of harmonized notes. The progression from one chord to another, while set in relation to the melody, does not occur as quickly as the progression of notes in the

[245] The notes of chords need not always be played simultaneously. The important factor is that the notes that comprise chords *sound* as if they are played simultaneously

[246] Lawn, 2013, 21-22.

melodic line. But the chordal progression, through timing and the harmonic relations within and between chords, creates a sense of rhythmic change. This rhythmic progression is called the *harmonic rhythm* or the *changes*. Within this harmonic rhythm, a harmonic "movement" occurs as some chords are perceived as creating tension and are released or resolved by harmonic structures in subsequent chords. This harmonic tension and release is known as *functional harmony*.[247]

From the earliest days of jazz, melodies and chord changes were improvised. However, very quickly, bands began to settle upon certain repeated turns of playing that became somewhat formalized into what became "arrangements" and later *head arrangements* or simply the *Head*.[248] Viewed from the standpoint of the performance as a whole, the head consists of the main melodic theme played in conjunction with the chord progressions of the harmonic rhythm (in a particular key and with a particular time signature). Additionally, intros, bridges, particular tempos, grooves, certain voicings, accents, and licks arrived at through improvisation, become standard inclusions in the head. Since romanticism, European "composition" has come to denote music that is written down in precise detail. The head, in contrast to this close notation, is usually only a single page (called a "lead sheet" with a book of lead sheets appearing in a "Fake Book") that serves merely as the basis for the structure of the entire song. It also provides the musicians with sufficient musical constraints or specificity to maintain ensemble integrity, while simultaneously defining the boundary conditions within which a great deal of improvisation may occur. The soloists must know the tune of a number, but all of the musicians must be familiar with the head. Thus, jazz in performance provides artists with enough parameters of correct play to maintain ensemble

[247] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 97; Lawn, *Experiencing Jazz*, 20.

[248] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 203.

integrity, but these parameters significantly underdetermine musical choices and thereby invite improvisation.

In this and the prior three sections, I have argued that both the structure and the social function of jazz emerge in a musical form that is designed to establish certain rhythmic, melodic, and harmonic parameters that enable and, indeed, invite individual improvisational potentials for action. By virtue of a defined structure that presents musicians with certain materials (notes, chords, rhythm-swing-groove combos) that have properties that can be manipulated while remaining true to the defined structure, musicians can improvise with variations of those sonic materials. This improvisation occurs within the context of the environmental ecology of the ensemble and within the broader ecology of a particular jazz style, genre, and scene. In what follows, I will begin to unfold intentional flows of jazz within a larger trajectory: the jazz song form as a whole and specifically improvisation within that form.

3.2.5 The Song Form and Order of Play

The head of a jazz song is usually a mere 32 bars long. As such, it is not what an audience might think of when considering the entire song. But the head comprises the elemental components of what become the entire song in performance. When moving from the melodic and harmonic specificity of the head to a performance of an entire song, jazz musicians make use of a conceptual device to convey the hierarchical structure of performance actions: the form. While two differing heads may have the same chord changes, they might have drastically different melodic components. The form will convey how many melodic lines a song has, whether or not they repeat

and the number of these repetitions.[249] Consequently, the head and the form of a song are tightly related concepts and in performance musicians will often refer to a statement of the head, which is also a statement of the form.

As part of the structure of jazz, *form* conveys a song's second highest level of architectural segmentation. The form is itself built upon a *main theme*, which is eight-bars long in most jazz prior to the free jazz of the 1960s. Throughout the course of a song, the main theme is repeated and sequenced with bridges, other themes, and reprises. For example, the Ragtime form, a musical ancestor to jazz, often begins with a main theme (A), which is repeated and then followed by a second theme (B), also repeated. The form then repeats the (A) theme and continues to doubled C and D themes. This standard Ragtime form is notated AABBACCDD. In the early days of jazz, many of the popular tunes that served as the form for jazz followed a song form of ABA or AABA. The latter form became the most common used in jazz. Each section of the form is typically 8 measures long (sometimes 2 4-measure phrases). The B section is called the *bridge* or *channel*, and a statement of the entire form is often called a *chorus*.[250]

The highest structural level in jazz arises when choruses are joined together. Usually this take the form of statement(s) of the head, solo improvisations on the head, and restatement(s) of the head. Berger claims that the head-solo-head structure is most basic piece of shared knowledge in jazz.[251] When a tune is "called" or selected for performance, the band plays one or two choruses (the full ABA or AABA head). This chorus is then repeated exactly or with variation. Next, the band enters the improvisational, solo section in which the rhythm section continues the head changes while each musician solos. The rhythm section in the order of piano, bass, drums almost

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[249] Lawn, *Experiencing Jazz*, 22.
[250] Ibid.
[251] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 96.

always solos last (except in trios). Each solo may last for one or more choruses depending on the whim of the musician. As Pittsburgh jazz vocalist, Maggie Johnson, told me, “Sometimes you just have more you’ve got to say. You’ve just got to get it out.”[252] The soloist will visually cue the other musicians that their improvisation is ending and at the end of the solos, the band will reprise the head. If improvisations begin to get too much out of hand, the reprise of the head can be quickly called, and musicians will often signal each other to return to the head by tapping their own head. Sometimes an outro or coda is added, and the song ends.

Bass and drum improvisational solos are less common than solos by the other instruments. The Bass solos more frequently than the drums, and sometimes the band will play “fours” in lieu of a drum solo. In fours, the lead or another soloist will begin with four bars of improvisation. Then the drummer will take over for four bars. Another musician will play for four bars, and the drummer will again solo for another four bars. This back-and-fourth between the drummer and the other musicians will continue for a full chorus, or a total of thirty-two bars.

We begin to see the unique improvisational flexibility within a simple, pre-defined set of parameters that jazz offers as an art form. Building from a basic head of thirty-two bars, usually written on a single sheet of music, an ensemble of musicians who may have relatively little or no experience working together can easily perform together with a great deal of mutual anticipation and cohesion in a highly improvisatory setting. Furthermore, since the basic contours of a song can be condensed into an easily readable head and only soloists must be relatively familiar with the song’s melody line, an ensemble can easily take requests to a variety of songs that they may not know very well. The order of play can be outlined as follows:

The Classic American Jazz Song Structure

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[252] Smith, Private Interview with Maggie Johnson of JazzSpace.

{The Song is Called}

{Intro. (Occasionally)}

{Chorus - Full Head - 32 measures}

{A section - 8 measures}

{A section - 8 measures}

{B section (aka Bridge or Channel) - 8 measures}

{A section - 8 measures}

{Chorus, repeated exactly or with variation}

{A section - 8 measures}

{A section - 8 measures}

{B section (aka Bridge or Channel) - 8 measures}

{A section - 8 measures}

{Solo Improvisations (Variation 1)}

{Lead - 1 or more Choruses}

{Soloist 2 - 1 or more Choruses}

{Rhythm Section}

{Piano - 1 or more Choruses}

{Bass (occasionally) - 1 or more Choruses}

{Drums (less common) - 1 or more Choruses}

{Solo Improvisations (Variation 2), aka “Fours”}

{Lead - 1 or more Choruses}

{Soloist 2 - 1 or more Choruses}

{Rhythm Section}

{Piano - 1 or more Choruses}

{Bass (occasionally) 1 or more Choruses}

{“Fours”}

{Lead or Other Soloist - 4 measures}

{Drums - 4 measures}

{Lead or Other Soloist - 4 measures}

{Drums - 4 measures}

{Lead or Other Soloist - 4 measures}

{Drums - 4 measures}

{Lead or Other Soloist - 4 measures}

{Drums - 4 measures}

{Chorus - Full Head - 32 measures}

{A section - 8 measures}

{A section - 8 measures}

{B section (aka Bridge or Channel) - 8 measures}

{A section - 8 measures}

{Possible additional Chorus}

{Coda}

{End of Song}

3.3 IMPROVISATION & EXPERIENCE AS A SPATIOTEMPORAL, SOCIAL PHENOMENON

In Chapter 2 I very briefly discussed the relationship between Aristotle's conception of the mimetic arts and the Romantic ideal of art for art's sake. In that section, I emphasized that although the Aristotelian conception of mimesis allows for a pursuit of art as an "end in itself," it is not an ultimate end and is always contextualized within the scope of the act of "making." The mimetic arts are a subdivision of *poiesis* (making or productive artistry), which is in turn a subdivision of *techne* (skill or craft). It seems no coincidence that as the Romantics lost the conceptual/linguistic expression of art to its artistry they also began to emphasize the composed musical work over the improvised composition (mentioned earlier in this chapter), which by definition references the enactive skill of the improviser.

Berendt and Huesmann point out that the Baroque and pre-Baroque musical periods preceding Romanticism demanded significant improvisatory skill of musicians. Original performances of a chaconne or an air by Bach, a concerto by Vivaldi, or sonata by Handle, while having been subsequently cast within romantic notions of ideal compositions, originally left much open to the improvisatory skill of the musician.[253] Somewhat surprisingly, Bach's method of providing an improvisational structure through specified harmonic progressions, mirrors the harmonic rhythm or changes of the head in jazz music discussed above. Berendt and Huesmann, however, argue that this similarity of improvisational technique does not imply a musical genealogical connection between pre-Romantic and jazz musicians. Rather, improvisation is,

> …basic to all musical cultures in which it is 'more important to make music yourself than to listen to the music of others,' in which the primeval nature of the relationship to music

[253] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*, 2009, 196-197

> does not allow for any questions of interpretation or conception to arise, in which the music is judged not according to what it *means* but to what it *is*.[254]

Naturally, a primeval relationship to music enacted through creation (one not based on the compositional expression of *conceptually articulated* meaning using theoretical rationality) opens up a great deal of space for unpremeditated experimentation with sound. In this type of relationship, the "musician" can do just about anything. Mistakes of performance are not possible. If there are no pre-defined standards of performance, there can be no mistake in performance. As was discussed in the prior chapter, intention is embedded in what we *do*, the *expression* of intention is the basis upon which mistakes arise. If improvisation is based on formless, enactive creation, mistakes cannot arise.

However, we have seen earlier in this chapter that improvisation in jazz occurs within a great deal of specified structure. Harmonic rhythm, for example, provides a considerable context within which a musician improvises. Consequently, while jazz improvisation occurs within parameters that differ from the meticulously defined characteristics of romantic and post-romantic compositions, which specify a "correct performance," the difference is a matter of degree.[255] A propositionally defined set of parameters in jazz performance (even if unwritten) open up potential for mistakes in performance, which is crucial to the characteristic freedom and liveliness in jazz. As Berendt and Huesmann state,

> The essence of improvisation includes a liking for spontaneity and a positive attitude that lets the musicians believe in the possibility of successful playing even given all the surprises and difficulties that can arise in a musically open situation. This attitude includes the conception that apparent 'mistakes' actually open windows onto a new, previously

[254] Ibid., 197. Emphasis added.

[255] Even composed works leave open extensive interpretative leeway in performance. But this is merely the difference between theoretical and practical knowledge.

> hidden world, accessible by finding a logical way to integrate the 'mistake' into a convincing whole.[256]

Head arrangements, providing a clear set of parameters in the melodic theme and harmonic rhythm, are usually written on a lead sheet, but often lead sheets are not used; the musical details of performance are simply known within the collective jazz consciousness through reference to recordings that have become jazz "standards." Musicians in the early days of jazz frequently relied on this collective memory. Many early jazz musicians could not read music, so head arrangements were not always written down; through repeated rehearsals, they became sufficiently familiar with head arrangement play and improvisation.[257] The advent of recording technology also contributed to the development of jazz standards, not only head arrangements but also improvisations on those arrangements. Jazz was, in fact, the first musical form to gain and grow in popularity aided by aural recording technology.[258]

The head arrangement provides a key element to the primary feature of jazz, improvisation. As we begin to loosen the threads of intentionality within improvisation, we very quickly discover a key to understanding how these intentional threads can overcome the problem outlined at the beginning of this chapter: the difference between the performance of intentional action and the experience of those intentional flows created in performance. This difference presents a challenge to this dissertation because a difference between the production and experience of intentional flows might entail that design for audiences should be focused on the experience of intention while the design for musicians should focus on the production of intentional action. I will rely on improvisation as the locus of the solution to this difference between the *enaction* of performance

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[256] Ibid., 197–198.
[257] Berendt and Huesmann, *The Jazz Book: From Ragtime to the 21st Century*.
[258] Lawn, 2013, 27.

and the *perception* of intentional flows within a performance. I will rely on Berger's helpful analysis of the organization of attention by performing musicians to demonstrate the effectiveness of improvisation as a solution to this apparent dilemma.

Berger's thesis might be summarized as follows: jazz requires the performing musician to be an actively experiencing musician attentive to the flows of intentionality within the group, placed in relation to the given parameters of performance, through a process of actively foregrounding and backgrounding elements of experience as they process through time and relate to a hierarchy of musical, social and cultural values.[259] In what follows, I will examine the pieces of Berger's thesis in a bit more detail, but it is important to point out at the outset that implicit within this thesis is the idea that jazz performers cannot succeed in laying down threads of intentional action apart from active participation as observers of the group, the parameters, and the performance environment all in relation to pre-established values. Perhaps this could be said of nearly any form of group performance. However jazz improvisation demonstrates this give-and-take between action and perception of action to a heightened degree. The improvisatory nature of jazz places the jazz musician in as much of an interactive role as it does in a performative role. Jazz performance occurs through interactive co-creation. Consequently, the process of improvisation provides powerful resources for the study and design of interaction. In a very real sense, Jazz is interaction design through performance.

Berger's thesis mentions the parameters of performance. I have discussed some of these parameters briefly and will return to them shortly. His thesis also mentions foregrounding and backgrounding of experience, the procession of experience through time, and the importance of values as guides to experience. I will discuss each of these issues in turn.

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[259] Here, of course, I am paraphrasing Berger, generously interspersing some of my own terminology.

Foregrounding and backgrounding experience is a concept taken from Husserl's phenomenological concept of the horizon of experience.[260] When we have an experience, for example a visual perception, we ascertain certain features of that experience through the perceptual information that impinges upon our visual receptors. For example, we may see the edge of a table, but there are other aspects of that experience "beyond the horizon" of our experience, which are nonetheless implied by the experience. For example, the far side of the table which is occluded by the near side of it. Indeed, we know empirically that our visual receptors present a quite limited "representation" of what we actually see.[261] Much of the content of visual experience is arrived at as we interact with objects of perception or infer certain things about them either from their shape or from past experience from similar objects. For example, I may walk around the table to see the other side of it, or I may infer from perspectival convergence of lines that the table has a certain shape, or I my intuit the existence of a leg holding up the far side of the table based on my knowledge of the vertical orientation of the table and centers of gravity in table-like structures. I may walk to the other side of the table and be surprised by some trick of engineering to find that the table in fact lacks a leg on its far side, but even in this simple act my perceptual experience relies on interacting with my experiential horizon by shifting my position to place the far side of the table within my horizon of perceptual experience. Berger provides a visual example of foregrounding and backgrounding when viewing an image of Ruben's Goblet. By foregrounding the silhouette in our attention to the image, we see a goblet with an intricately fashioned stem. By

[260] Husserl, *Ideas for a Pure Phenomenology and Phenomenological Philosophy*; Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 122.

[261] See Gallagher and Zahavi, *The Phenomenological Mind : An Introduction to Philosophy of Mind and Cognitive Science*, 89–94. for a more extended introduction to the phenomenological argument against perceptual representationalism.

foregrounding the white space that surrounds the goblet, two faces in profile facing each other (which create the goblet stem) emerge within our perceptual focus.[262]

These examples reference the importance of spatial relations in forming our horizon of experience, but this horizon is also in large part determined by our choice of focus over time. At differing points of their performance, jazz musicians will focus on differing aspects of the melodic line, certain relations within the harmonic rhythm, or on the tempo or groove. This shifting of focus is often determined by roles within the ensemble and the particular values of the musician. For example, bassists and drummers are primarily responsible for establishing the tempo and groove. If tempo is strong and the ensemble is grooving well, then they lessen focus on these elements and bring other elements into focus, possibly the chord changes or an upcoming transition from one soloist to another. Within background experience, phenomenologists distinguish between the "defining" and the "receding" background. Certain background musical elements are more important than others. These become the "defining background" within which we contextualize foreground experience. Other aspects of the background recede from focus, becoming less crucial to the overall "texture" of experience perceived as a gestalt.[263]

The effects of time to our conscious experience of perceptions also pertains to phenomena that Husserl termed retention and protention.[264] Most aural phenomenon of any duration has a past, present and expected future. We can abstract out the present moment within this past, present, future flow, but in experience we seldom abstract out a "now" moment, what Husserl calls a

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[262] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 123–124.
[263] Ibid., 124.
[264] These concepts come from Husserl, *The Phenomenology of Internal Time-Consciousness.*

"primal impression."[265] Rather, "now" moments always occur within the context of the *retained* past and the *protended* future.

The retained past is our present awareness of what has just past. Gallagher and Zahavi explain that "There is no simultaneity between the retentional aspects of consciousness (which is current) and that which is retained (which is just-past)."[266] The event that has just past is, indeed, just past. What remains in consciousness is not the event itself, but our retained perception of it as the immediate past. Similarly, retention is not considered to be a remembering of the past, but rather the experiential impact of that past experience on the present. While retention holds the past within the present experiential moment, protention is an anticipation of what will follow our present moment of experience.

During daily conversation, we often anticipate what an interlocutor will say. As will become clearer later on, the means by which protention occurs in a jazz band are multiple, but in *Interaction Ritual Chains*, sociologist Randall Collins links the ability to protend within social interactions to shared, focused attention on a single object about which the interactors have a shared emotional response.[267] As group interaction continues, the shared act of focused attention and emotional response becomes stronger, and competing emotions are excluded. Collins argues that this entrainment of action and response arises out of and contributes to increased ability to protend. He states that,

> On the ultra-micro level, this happens by the process of rhythmic entrainment physiologically. That is to say, activities and emotions have their own micro-rhythm, a pace at which they take place. As the focus of interaction becomes progressively more attuned, the participants anticipate each other's rhythms, and thus become caught up "in the swing of things." Participants feel sadder in the course of a funeral, more humorous as part of a

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[265] Gallagher and Zahavi, *The Phenomenological Mind : An Introduction to Philosophy of Mind and Cognitive Science*, 76.

[266] Ibid.

[267] Collins, *Interaction Ritual Chains*, 108.

> responsive audience at a comedy show, more convivial during the buildup of a party, more engrossed in a conversation as its rhythms become established.[268]

Acting toward a shared objective, or end, and sharing an emotional response to that end are both facilitated through entrainment aided by protention. It is also interesting that Collin's example focuses on rhythm and the "swing of things." The connection to jazz is apparent, and the validity of rhythm as a source of entrainment is important. But it is helpful to remember that jazz, while laying down a regular rhythm, uses syncopation to fill in accents around that regular rhythm as an expression of the individual player's sense of groove and the appropriateness of accent within the regular rhythm. Hence, if jazz facilitates entrainment and group cohesion through regular, repeated, and therefore anticipated rhythmic pulse, it leverages that anticipated action of beat creation to accentuate performer actions that express individuality in syncopation and groove. Both of these emphases on the action of performers rely on our ability to protend in experience. As the beat is played, the regular rhythm enables listeners to begin to protend the next beat in the tactus. Syncopation and groove leverage this protended regularity of tactus, emphasizing the irregularity of the actions that produce syncopation and groove.

Retention and protention, foregrounding and backgrounding elucidate active aspects of a musician's process of experience in performance over time and through space. But these aspects of active experience alone are insufficient organizers of jazz experience and performance within that experiential context. There are many objects of experience that a jazz musician can foreground and background, retain and protend. The musical elements discussed in the prior sections of this chapter constitute a primary aspect of focus and experience for musicians, but each musician must

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[268] Ibid. See also, Stromberg, *Caught in Play*, 87, and Nussbaum, *Upheavals of Thought*. Nussbaum's provides a compelling look a the teleological nature of emotion as a surfacing of deeply held values relative to personal perceptions of human flourishing or our lack thereof.

also attend to these elements within the context of the other performers in the ensemble, attending to how and why various musical elements are or are not working. Beyond ensemble dynamics, musicians may also choose to attend to their own physical space on the bandstand, the musical instrument that they play, their body performing in relation to the instrument, the performance venue, audience applause or lack thereof, entrances and exits of patrons to the venue, sounds outside of the venue, etc.

How and why musicians pick out, foreground and background, retain and protend among diverse experiences is a processes guided by a hierarchy of bodily, musical, social and cultural priorities or values. Some of these values will be shared more or less universally across musicians and audiences. Smoke billowing from the kitchen of a jazz club will alarm all who perceive it due to the instinct value of self-preservation. Other experiences may simply overpower others; a jet engine roaring low overhead or a siren blaring down the street outside of the venue can command attention. These experiences can direct attention away from the performance, but they also provide experiential material ripe for improvisational elaboration by musicians. Jazz musicians have been known to mimic sirens, animal noises, and human voices. They have also been know to alter an improvisation around a particular patron's entrance into the venue.

However, beyond the basic instinctual, overpowering or socially significant ordering of experience, musical values guide performers' experience and action in performance. How musical values impact any given performer's action within an ensemble will depend to some extent, individual preference. Nonetheless, Berger observers that maintaining rhythm, harmonic changes, and the head melody constitute the primary values for musicians. These three things are the basic

"parameters" of jazz performance.[269] When the ensemble is holding these elements together well, then the individual members are free to background the parameters and focus on other elements of play. At other times, struggling to maintain one or more of the parameters may demand full attention. If maintaining the basic parameters of performance constitute the primary musical value of all ensemble members, how they are maintained, the actions in performance guided by this shared value, give rise to shared roles and feedback loops upon which interaction is based. I will examine these shared roles and feedback loops in the rhythm section (bassists, pianists, and drummers) and relate this interactivity to solo improvisations.

3.3.1 Maintaining the Parameters and Intermusicality within Improvisation

In an excellent work, *Interaction, Improvisation, and Interplay in Jazz*, Robert Hodson examines the roles that members of small ensemble rhythm sections hold in relation to the basic parameters of rhythm, groove and the harmonic changes.[270] Bassists, pianists, and drummers fill mutually supportive roles that form balanced triadic relationships within the rhythm section. These roles are based on each member of the trio's contribution to the basic parameters of jazz performance and rely on close interaction among the members that involves each member in a feedback loop between action and experiential observation.

A bassist's roles are harmonic and rhythmic. Walking a quarter-note base line, the bassist provides the steady pulse or beat of the song. But this pulse also carries the harmonic progression

[269] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 129–145. Berger specifically credits an Akron, OH musician, Eric Gould, with the idea of "Parameters."

[270] Hodson, *Interaction, Improvisation, and Interplay in Jazz*, 29–40.

as the bassist improvises on the basic structure of chord changes outlined in the head arrangement. Berger explains that,

> Many different chord qualities based on one root serve the same harmonic function; for example, if the tune requires a C chord as a tonic, the player can play a C major seventh, ninth, eleventh, or thirteen—all of which indicate to the listener that that chord is a tonic. Further, the player is free to voice the chord (stack the notes of the chord in different octaves) as he or she chooses. While each style has typical chord qualities and voicings, the chordal players…improvise their specific accompanying parts on the bandstand. They are also free to employ passing chords, substitute new chords, or even superimpose new chord progressions, as long as the parts they play give the right tonal sound and don't interfere with the head melody or their solos.[271]

Through improvisational variation on the chord changes, bassists can carry the rhythmic pulse and changes while simultaneously developing a new melodic line that supports the main melody carried or improvised upon by the front line.[272]

The drummer aids the bassist in defining the regular rhythm by creating what is known as the *backbeat* and the *ride pattern*.[273] The ride pattern supports the bassist's quarter-note pulse as the drummer plays a quarter-note followed by two swung eight-notes on a suspended cymbal that is designed to have a sustained sound after it is struck. The sustain fills the rhythmic undercurrent of the quarter-note pulse and gives the ride cymbal it's name—it "rides" with the music. It is usually placed on the right side of the drum kit (near the musician's dominant hand) because of its central function of carrying the quarter-note pulse.

The drummer uses two small cymbals, the "high-hat," to carry a secondary "backbeat" on the second and fourth beats of each bar. Mounted one above the other on a stand, the high-hat cymbals can be left open or held shut by a foot pedal, and drummers will at times strike the cymbals in either of these positions. But the backbeat is usually created using the left foot to clash and hold

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[271] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 95.
[272] Hodson, *Interaction, Improvisation, and Interplay in Jazz*, 29.
[273] Ibid., 30–31.

the two symbols together. The foot pedal action creates a "…short, crisp, dry sound often rendered onomatopoetically by the word 'chick.'"[274] This combination of short, percussive backbeat accentuated and texturally filled by the ringing ride cymbal is accompanied by non-regular rhythms on the snare drum, tom-toms, bass drum or crash cymbal, which support the melody and improvisations of the front line. Hodson identifies three ways that this support occurs, which matches the phenomenology of perception over time. Drummers may either *react* to the front line, building off of the retained past; coordinate or "lock up" with the front line, building off of the abstracted "now" moment; or they may leverage protention to anticipate or "set up" the front line.[275]

The pianist cooperates with the bassist in providing the harmonic, chordal progression. Like the bassist, the pianist utilizes differing voicings and chord qualities that accompany or compliment the head melody, but the pianist does this with much greater rhythmic diversity and syncopation. With the drummer, the pianist can rhythmically react to, lock up with, or set up the front line.[276] The pianist's role in defining and improvising on the chord and rhythmic parameters is immensely complex. I will not attempt a more detailed examination of this role; the important point for my purposes lies in the relations between the various players of the rhythm section in maintaining the parameters. Hodson provides this helpful schematic of these relations:

[274] Ibid., 31.
[275] Ibid.
[276] Ibid., 33.

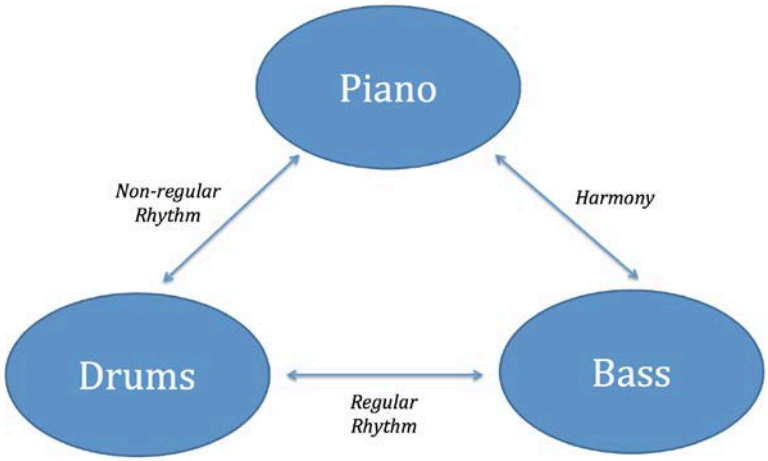


Figure 3.1 Schematic of relationships within rhythm section[277]

In these series of relationships and dynamic interaction among the members of a jazz ensemble, we can see that the actions of individual musicians occur within the structure that provides context for social functioning among the group. Much has been written that traces the specific flow of interactions among musicians and examines the music theory behind these interactions. What is important to understand for our purposes is that the basic parameters of jazz performance are upheld within these triadic relations among drums, piano, and bass. Where a musician focuses their experiential attention and active play (for example, a pianist's focus on non-regular rhythm in relation to the drums or harmony in relation to the bass) will depend on his or her objective of maintaining the basic parameters in relationship to the performance of the other musicians. The actions of the performers can therefore be modeled to include experiential feedforward and feedback as they protend their own performance and the performance of the other musicians as well as retain that performance in the current moment of play.

[277] Re-created from image in Ibid.

Hodson modifies a model of interaction in jazz performance developed by Jean-Jaques Nattiez. Nattiez creates a linear relationship model of musical creation and reception. He proposes that poetic process in composition moves to the "Trace" of performance embedded in either sound or written score. Then from the other direction aesthetic reception apprehends the aural/written trace.

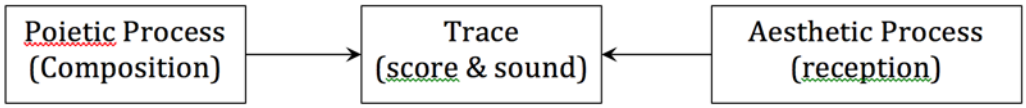
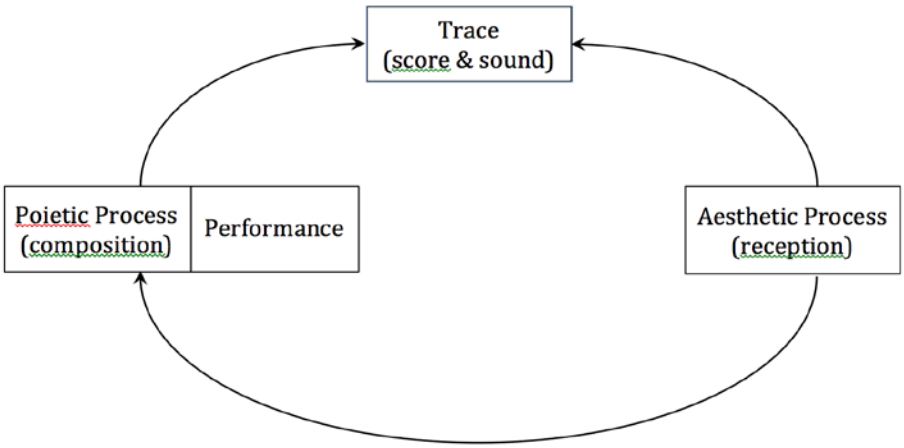


Figure 3.2 Nattiez's three dimensions of a musical work.[278]

Hodson argues that Nattiez's model must be altered for jazz improvisation. The correct model involves joining poetic process (composition) to performance and placing this conjoined activity within a feedforward and feedback loop. Poetic process in performance creates a Trace (score & sound), which is then apprehended in aesthetic reception. This reception then informs the compositional process in performance. Hodson diagrams his altered model as follows:



[278] Re-created from image in Ibid., 15. See also Nattiez, *Music and Discourse: Toward a Semiology of Music*.

Figure 3.2 Hodson's alteration of Nattiez's model for improvisation.

Hodson's altered model is, I believe, correct insofar as it goes. The performing artist observes his own performance and the performance of others (feedforward). He then incorporates what is observed in real-time into his developing, improvisational performance. However, given Berger's observations on improvisation and what we know of human action, I do not believe Hodson has gone far enough. The one-way relationships from reception to composition/performance and from reception to trace should actually be two-way relationships represented by arrows on both sides of the connecting lines. The diagram would appear thus:

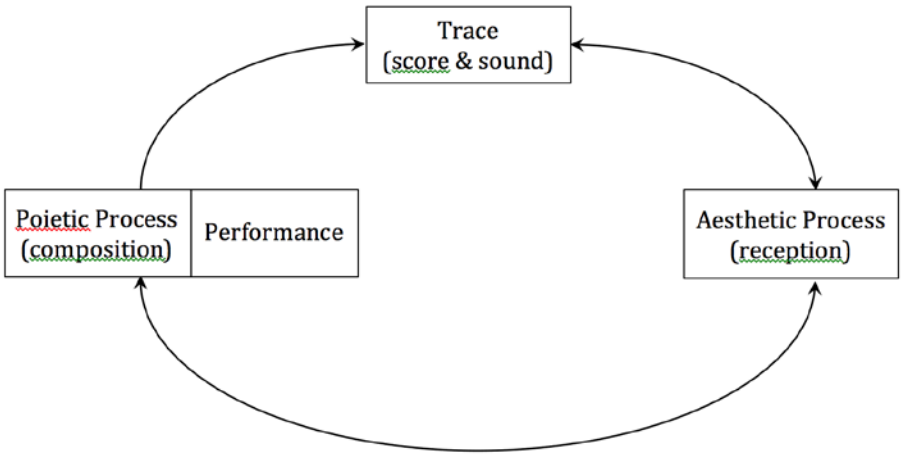


Figure 3.3 Alteration of Hodson's Improvisation Model Following Berger

The importance of the dual relationships (dual arrows) is not trivial. Berger argues that the performing, improvisational artist is engaged as much as a listener (reception) as she is a performer. Protention is therefore a part of both artistic creation and reception. While the musical trace is a product of performance, reception involves the artist actively protending both her own next performance action as well as the actions of the other musicians. Similarly, reception does not merely feedforward to inform subsequent performance actions; performance also feeds forward

into the active reception of performance as artists choose which actions to foreground or background.[279]

This reciprocal feedback loop is crucial to understanding how the members of an ensemble maintain the parameters of the song. The action-in-experience feedback loop enables an artist to closely monitor the playing of other members of the ensemble and adjust to match their play or offer subtle hints to correct their performance if they begin to disrupt elements of the group's cohesion around the parameters. But ensemble members also improvise within these basic parameters, and the reciprocal feedback loop plays a crucial role in this real-time improvisation during the flow of performance. When a group is functioning well together, accompanying musicians will background the parameters and foreground their own improvisation around the improvising soloist. This is known as "comping," an abbreviation of "accompanying" or "complimenting," and will become the subject along with solo improvisation of the next section.

3.3.2 Comping and Solo Improvisation

Comping musicians function with such remarkable speed and fluidity as they listen and respond to the soloist and the rest of the ensemble that they cannot engage in extensive planning of their improvisations.[280] Hearing the ensemble in action, protending the upcoming direction of play and responding accordingly relies on the musician's capacity to play within the reciprocal feedback loop in which experience is directed by action and action is directed by experience. Berger explains that, "While sharply focusing perception, planning action, and monitoring the enactment of those

[279] This model is also supported by current models of efference copy and reafference in predicting and confirming the outcome of movements.

[280] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 140–141.

plans may be necessary to correct problems, [a musician's] preferred performance is an effortless and non-reflective flow filled with nothing more than the sound of the instruments."[281] The planning that musicians engage in on the stand is seldom a linguistic "voice inside the head." Rather, musicians speak of merely "hearing" their improvisation in rich detail as a "…vague awareness of the upcoming parts that runs continuously into the present perceptual moment and beyond that into the recent past. It is unlike conceptual plotting and planning in that it is an experience of sounds and not concepts or words."[282] The process is so fluid that musicians speak of their instruments "playing themselves."[283] Obviously, the instruments do not "play themselves," but the significance of this statement should not be overlooked. Given the years of practice required to develop the skill of jazz improvisation, how could musicians arrive at this description?

In an interesting chapter on anticipation in musical experience, Daniel Levitin explains a number of ways that we anticipate the unfolding of music over time. The first way that anticipation occurs relates to important musical relations studied in music theory. Levitin explains that musicians "organize" the sounds in their compositions around a root chord that serves as the starting place of the chord sequence in a song (the harmonic rhythm). We naturally expect a song to resolve back to its root chord, and composers will frequently repeat a chord progression that resolves back into its root to accentuate this recurring pattern and build expectation. This progression is called a "cadence." We have already seen how this technique is built into the song structure of jazz in the ABAA song form and in the order of choruses. However, musicians will also use the expectation built by the root chord and the chordal progression to create a "deceptive cadence" in which a repetition of the chord progression does not resolve. Instead, an unexpected

[281] Ibid., 130
[282] Ibid., 132.
[283] Ibid., 130.

chord is played that is nonetheless still within the same key as the reset of the song. This creates tension and builds expectation that a) the song is not over and b) the root chord will be played to resolve both the chord progression as well as the deceptive cadence.[284] But it is not as though this manipulation of cadence requires conceptual articulation by the performing musician.

A musicians intimate practical knowledge of a particular song and their knowledge of chordal structures, rhythms, and grooves enable them to maintain the parameters and improvise upon them with very little conscious monitoring or even awareness of the theoretical implications of their performance within the ensemble.[285] When things go wrong, the need for conscious monitoring arises because a mistake in performance has occurred, which by our analysis of action references an expression of intent in the head arrangement or in music theory. However, even these conscious adjustments are usually swiftly passing moments within the context of immersion in the band's playing. If a musician does mentally "pause" to plan an improvisation, it is unlikely that this planning will engage significant propositional content.

Jazz musicians and communities hold differing opinions about planning during improvisation. The Akron, OH jazz ensemble studied by Berger adamantly resisted conscious planning of improvisations.[286] The younger Cleveland, OH jazz community, which was much more comfortable with later jazz genres, engaged in much greater use of planning on the stand during improvisations, but this planning was still short, involving a process of split-second reflections punctuated by key moments of slightly longer duration in which a plan emerged for the

[284] Levitin, *This Is Your Brain on Music*, 109–110. Levitin also argues that rhythm can build expectation. I have argued a similar point above when noticing that syncopation and swing notes function based on the anticipation of a regular, rhythmic pulse.

[285] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 146–147.

[286] Ibid., 36–37.

overall form of the solo.[287] Interestingly, the older generation of musicians in Akron were very well versed in jazz standards and expressed frustration with the younger generation of musicians who often received significant training in musical theory but had a less detailed or expansive knowledge of jazz repertoire. Even so, the use of theory in the Cleveland scene could not account for the complexity of their improvisations. They placed emphasis on attaining a clear idea of the "direction" that one sought to achieve in the improvisation as a whole or within segments of it. One musician stated that this direction could be anything, "…a plan to play with a certain physical technique, to aim the melodic contour at a particular note, to employ a type of harmonic materials or to play in a certain style."[288]

Physical technique and musical style correspond to another method of anticipation described by Levitin—learned structure conceptualized as "musical schemas."[289] Levitin says that "We have learned that certain sequences of tones go together, and we expect them to continue to do so. We expect certain pitches, rhythms, timbres, and so on to co-occur based on a statistical analysis our brain has performed of how often they have gone together in the past."[290] I am hesitant to attribute consciousness to a subset of neural functions involved in our conscious experience of music. I that imagine that Levitin actually means that those who understand both neuroscience and statistics can apply certain statistical analyses to certain neural firing patterns in our brains as we listen to music. A similar point applies to his later statement that, "An important way that our brain deals with standard situations is that it extracts those elements that are common to multiple situations and creates a framework within which to place them; this framework is called a

[287] Ibid., 139.
[288] Ibid., 138–139.
[289] Levitin, *This Is Your Brain on Music*, 113–115.
[290] Ibid., 113.

schema…the schema leads to clear expectations, as well as a sense of which of those expectations are flexible and which are not."[291] Cognitive schemas within embodied and extended cognitive studies have been attributed to not merely a brain process, but a brain process in the context of its environment.[292] Levitin seems to tacitly acknowledge that schemas are dependent on a pre-existing structure within the world when he refers to "…those elements that are common to multiple situations…." Aside from these caveats, Levitin's points are well taken. He continues to say that "As listeners, we recognize when we are hearing something we've heard before, and we can distinguish whether we heard it earlier in the same piece, or in a different piece."[293]

Beyond the schema defined by in a lead sheet, jazz musicians build improvisations out of their (often) vast repertoire of knowledge of jazz. Berger writes that, **"**Knowing a tune…means knowing more than just the head melody and changes, and it is at this point that specific aspects of style within each musical scene can be elucidated. The phrase "head arrangement" refers to knowledge of hits, accents, elements of form, and typical voicings that are specific to each particular scene…Some head arrangements are specific to the players of a local scene, while others arise from famous recordings, and the line between required head arrangement and optional musical device is both blurry and contextual."[294] If hits, accents, elements of form and remembered phrases can add context and shape to the head arrangement, they also inform improvisations around that arrangement. Often a musician will use a memorized phrase buy time or clear mental space as the next section of the improvisation is envisioned—those split-second and slightly longer moments reflection referred to above. As also mentioned above, musical schemata—physical

[291] Ibid.
[292] Johnson, *The Body in the Mind*.
[293] Levitin, *This Is Your Brain on Music*, 115.
[294] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 96.

technique, melodic contour, harmonics, style, etc.—can serve as the "end" that the improvisor seeks to attain.[295]

As argued in the prior chapter, this "beginning with the end in mind" is a central feature to the logical structure of practical rationality. It illustrates the essentially practical nature of tracing intentional flows within the *process* of improvisation. Some have argued that rather than pointing to the essentially practical nature of improvisation, the use of techniques, melodic contours, hits, licks, styles and the like actually constitute a syntactical, linguistic dialogue between musicians, a product of theoretical rationality. However, Ingrid Monson argues that the differences between musical communication and linguistic communication warrant clear distinction. She states that,

> In jazz improvisation, aural references are conveyed primarily through instrumental means—that is, without words. While it is possible to speak of these references as the intertextual aspect of music, I prefer to call them intermusical relationships to draw attention to a communication process that occurs primarily through musical sound itself, rather than words. The word intermusical is best reserved for aurally perceptible musical relationships that are heard in the context of particular musical traditions…The complicated relationship between written and aural modes of musical knowledge, it seems to me, must be carefully distinguished. While the more generalized usage of the term intertextual in literary studies can include music as a specific mode of textuality,…it seems that musical scholars have had sufficient difficulty distinguishing cultural meaning conveyed by text, music in its written aspect, and music in its aural aspect so that a specifically musical term would be useful.[296]

To illustrate this point, Monson provides a conversation she had with jazz drummer Ralph Peterson. Peterson had used an Art Blakey rhythm on the stand, which spawned a response from another musician that reminded Monson of Dizzy Gillespie's "Salt Peanuts." Yet, when Monson

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[295] "Style" is perhaps a bit ambiguous. The practical implications are nonetheless important. To explain style a bit further, I quote Berger: "In some styles of jazz, the bass player largely plays walking bass—a constant flow of quarter notes that serve to define the harmonic and rhythmic framework of the tune. In more contemporary styles, the bass player may break free from the rhythmic restraints of a walking bass line. In either case, the notes the bass player chooses always emerge in relationship to the changes. In older styles of jazz, the bassist tended to play the roots or fifths of the chords on the first beat of the measure to make the changes as clear to the listener as possible; in more recent styles the player has become freer in his or her note choices. Ibid., 97.

[296] Monson, *Saying Something: Jazz Improvisation and Interaction*, 127–128. Monson here references Hanks, "Text and Textuality."

mentioned “Salt Peanuts” to Peterson, he immediately made the connection, not based on the response from the other musician, but rather because the Art Blakey rhythm was identical to a rhythm used in “Salt Peanuts.”[297] Manson and Peterson arrived at the same reference point through the same musical interaction, but by differing means. Their linguistic social interaction *about* the musical social interaction took the form of an expanded description of the intentional flows within the musical interaction, but the musical social interaction did not contain linguistically descriptive content. It followed a pattern of give-and-take between the musicians, but the fluidity of this give-and-take in large part depended on the *lack* of expression of intent. The musicians actions and interactions *underdetermined* the propositional expression of intention by both the musicians themselves in their interpretation of each other’s performance actions during the performance and later during the discussion of the interaction by Monson and Peterson. As Monson argues, “The indivisibility of musical and interpersonal interaction underscores the problem of thinking about jazz improvisation as a text. At the moment of performance, jazz improvisation quite simply has nothing in common with a text (or its musical equivalent, the score) for it is music composition through face-to-face *interaction*.[298]

Interaction among musicians on the stand places each comping and soloing musician within a social context as they play for each other and against each other, but these interactions usually occur within the context of a club or concert venue. I have already mentioned that jazz musicians have historically found inspiration for improvisation from everyday noises that impinge on their performance such as animal sounds, sirens, and the like. Entrances or exits of particular patrons of a jazz club have also been known to impact the development of an improvisation. While

[297] Monson, *Saying Something: Jazz Improvisation and Interaction*, 128.
[298] Ibid., 80. emphasis mine.

these improvisations are not as socially intimate as the interactions between musicians on the stand, they nonetheless present an important facet of the performance ecology within which improvisation occurs. Additionally, these interactions with that ecology occur within the same musical form and rely on active, experiential retention, protention, feedforward, and feedback loops.

Most attentive audience members will easily identify soloists' improvisations on a main melodic line. However, they may not easily trace the intentional flows of that improvisation as they build from a complex web of four variables: 1) structural, musical parameters within the song, 2) dynamic attentional interplays among musicians as they maintain those parameters, 3) quickly formulated objectives or "ends" of the improvisation around the parameters, and 4) the particular environment in which the improvisation occurs. This logic of intentional flows (again, briefly summarized as "doing one thing *in order* to do something else") and motivations (the ends or objectives that stand apart from the logic of intentional flows) may not be readily apparent to the perceiving audience. Motivations may arise out of an improvisor's knowledge of jazz history, the harmonic relationships within the head, the real-time interactive accompaniment of other musicians in the ensemble, entirely unrelated environmental stimulus from within and outside of the performance venue, or the improvisor's, often humorous, sense of experimentation with sound. In short, improvisation presents listeners with a dynamic of complex intertwining musical intentions. Untwisting and tracing the specific logic of individual threads of intention that comprise any single improvisation is beyond the scope of this dissertation and I need not attempt it. Instead, I have in this chapter attempted to merely "slack the threads of intention" usually enacted in an improvisation to better understand the act of improvisation in more general terms.

3.3.3 Improvisation and Freedom to Choose

We have seen so far in this section on Jazz and Intentional Flows that jazz is a complex art form that displays an identifiable structure of human action. This action structure is technical in the sense I have defended in the prior chapter. Jazz functions by use of a technical system that in performance defines a steady pulse (rhythm), variation on that pulse through swing and groove, sequences of notes in a horizontal, temporal progression (melody) as well as in vertical, harmonic simultaneity with changes over time (harmonic rhythm). Furthermore, all of these structural features are iterated through a repeating song form, with sub-patterns of variation within choruses (for example, improvised "fours").

Much of this technical structure functions on top of certain other human technologies, for example, lead sheets and the instruments that comprise a typical jazz ensemble. Lead sheets present this structure in a very basic set of propositionally conveyed "instructions." Throughout the over one hundred years of jazz, many of these instructions have become standardized through lead sheets or a definitive sound recording of a particular song. But the head arrangement does not have to be written down, it may be conveyed in the *practice* of a jazz ensemble, and in many circles this is precisely how it is conveyed.

A jazz ensemble also executes its action of performance, within the social context of the ensemble, thereby introducing not merely the transmission of pre-established socio-cultural normalizing forces within its performance but also introducing the enactment of other socio-cultural normalizing forces within the performance. A performer's social and cultural history can impact his perception of personal performance as well as perceptions of the performance of other ensemble members and the ensemble as a whole. But how do these normalizing forces of past and present practice influence individual performance? Berger argues that individual action displays

close interdependence with socio-cultural normalizing forces.[299] These forces cannot determine the action of an individual, the individual is always free to "choose otherwise," but social and cultural forces can influence the choices a performer makes. As a general assessment of the influence of society and culture on individual action, I believe that Berger is a correct. However, generalities have limited usefulness. Before concluding this chapter, it is helpful to observe two points about freedom of improvisation within the context of socially constituted practice. These points are based on the analysis of action it the prior chapter,

First, insofar as a choice requires social participation, a performer does *not* always have "freedom to choose" something other than what is socially or culturally prescribed. A jazz performer performs (usually) in concert with others in the ensemble. He may wish to perform a final number as an ensemble before ending a set, but if the rest of the ensemble chooses to end the set without playing a final number, then the musician can hardly choose to play a final number as an ensemble. This is relatively trivial, but it illustrates that the performer's freedom of choice in relation to socially and culturally specified norms (in this case, the norm of only playing until the ensemble chooses to end the set) is actually a freedom of *response* to socially and culturally specified norms. Another point is less trivial or obvious. Some cultural and social norms can specify the intentionality of an act regardless of any *expression* of that intention that the agent may provide. For example, a jazz band lead may attempt to "choose" to improvise a final solo that sounds identical to the final return to the head arrangement instead of playing the final head arrangement as is specified by the song form. At an intermission he may ask the other players how they liked his final improvisation in place of the return to the head. He will undoubtedly be met with blank stares. This is because despite what he thought he freely chose, he in fact *did not*

[299] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 147., 172.

improvise a solo that sounded identical to a final repetition of the head. He merely played the final head because, as Anscombe puts it, we *intended* what we *do*. His expression of that intention is incorrect, and while this is relatively easy to see in this example, it reveals that at times social and cultural norms function by specifying *expressions* of intention as well as the intentions that they express. However, conflicts in expressions of intention are not always as clearly defined as the conflict just described. This leads to the second point about freedom and socially constituted practice.

Usually conflicts between individual and public expressions of intention are subtle. For example, Berger provides a story of the first interaction between a drummer, named Bill, with a band with whom he had never played before. Bill had been invited to join the band from the audience and the rest of the band did not know that he was a jazz musician well versed in jazz history. Berger explains,

> The other players called the song "Get Me to the Church on Time," a favorite of Bill's. In a well-known recording by Andre Previn, the drummer on the recording filled the space between the end of the head and the beginning of the first solo with a press roll on the snare. Familiar with the recording, Bill played that press roll and gave it special emphasis; in doing so, he alluded to the recording and let the other musicians know he was really a jazz musician. In his words, the others heads spun around, and "they played their asses off." Here, the press roll is not so much a required aspect of the head arrangement as it is an in-group reference, but the distinction between the two depends on the players and the setting in which they perform.[300]

Bill's intentional action only achieved the desired effect because the rest of the ensemble recognized the reference to the jazz standard and comprehended this action as an expression of jazz knowledge. The press roll achieved Bill's desired end but only by an expression of the intention within that act shared by the members of the ensemble. Had the rest of the ensemble been unaware of the expression of Bill's intention, then he simply would not have achieved his end "to

[300] Ibid., 97.

alert the rest of the ensemble to my knowledge of jazz." While the intention would have remained the same, the action would merely have been an *attempt* "to alert the rest of the ensemble…." Expressions of intention therefore have great impact on the cultural and social determination of any given action. This is perhaps why the titles of songs are so important. That simple and often nebulous expression of intention can nonetheless have significant impact on the success or failure of the act of playing a song *in order* to achieve a given end. Song lyrics function in a similar way, albeit with greater specificity. As will be shown in the next chapter, this relationship between the intentional structure of an act and its social function through expression and shared experience will have a significant impact on the design of a system for audience interaction.

In this chapter, I have attempted to demonstrate how an action theoretic examination of live performance both avoids structuralism on the one hand and social functionalism on the other. Meaning is a derivative of active, lived experience of performance, which means that audiences are both dynamic participants in the experience as well as creators of expanded descriptions of both their own experience and the actions performed on stage. In the next chapter, I argue that this ability to "see beyond" intentional streams in performance to their meaning within an ecological context lies at the heart of technology creation. However, bridging the gap from the perceptual experience of action and its propositional expression to the design of a new technology requires that we "slack the threads" of intentionality a bit. To do that, I propose that we further dissect intentional flows into their material, formal, and efficient constituents—their Aristotelian causes. These causal constituents will position us to better determine the final cause toward which they are directed and guide the design of a complimentary technology.

4.0 PASSIVE-DYNAMIC INTERACTION DESIGN AND NYMBUS

In Chapter 2 I argued for a conception of both performance and technology as forms of skill or Aristotelian *techne* in which intentional flows are embedded through art—performances and technologies. Chapter 3 argued that when seeking to create a human-technology symbiosis through the mapping of intentional flows from one medium onto another, we cannot focus solely on the internal structure of intentional flows alone. We should not overlook the importance of the *experience* of performance flows by both performing artists and audiences. Because the experience of intentional flows involves a complex, interactive process that develops a feedback loop between perception and active attentional focus, intentional flows should not be reduced to mere structured behavior and mapped through one-to-one correlations between the source medium (live performance) and the target medium (a new technology for audience use).

When using intentional action as the basis of technology design, we must take into account the complexity of experience of these flows in two areas. First, we must account for the fact that the structure of intention alone does not tell us which flows to map or at what level of specificity. For example, low-level flows specified by behavior can pick out the tactus of musical progression; higher-level flows group and describe these lower-level flows by defining the time signature of the musical piece (itself comprised of beats-per-measure and note length). Music visualizers were given as an example of mapping low-level flows, resulting in limited, albeit visually interesting, effectiveness in conveying the musical significance of those low-level intentional flows.

Second, when mapping flows, we must take into account how flows function within human social and cultural dynamics—how flows are received by virtue of their social and cultural function and how the performance of flows reciprocally shape their own social and cultural

function. The solution to this reciprocal relation between structure and function was argued to hinge on the experiencing subject as both perceiver and agent—one who both watches and directs perception in a dynamic feedback loop of active perception. The experiencing performer and audience member is actively foregrounding and backgrounding intentional flows at various levels within the hierarchy of flows. Thus, while most experience occurs through an active process of ordering intentional flows at low-levels of abstraction (e.g. picking out the tactus and tapping our foot along with it), there are moments when our experience of an art form reaches Anscombe's "break" within a flow of intention, at which point we must appeal to an expanded description of the act in order to comprehend its meaning(s). Such an expanded description usually appeals to an expression of intentionality that will very likely appeal to or rely on the social and cultural context within which the action occurred. This is the cultural and social function impacting experience.

In Chapter 3 I also examined the way that Jazz as an art form, a techne, creates human-techne symbiosis. By design, jazz provides distinct structure of intention in the parameters of performance while insuring that those parameters underdetermine the actions of the performer. Underdetermination invites improvisation. Jazz also forms the social and cultural context for performers by placing them within an ensemble that mutually understands its place within the historical development of the art form. Jazz creates a physical, social, and cultural ecology designed to compliment performers as agent-experiencers. Jazz musicians engage in an active perceptual process among other experiencing-agent musicians in the ensemble. Thus, I argued that jazz is a proto-interaction design that creates human-technology symbiosis.

This analysis would seem to indicate that jazz, in regard to its design in a specific genre, is a "completed" art form. The addition of any other techne would disrupt this design of the form by altering the ecology that it creates. This is in part true, but this truth does not inhibit the growth or

evolution of jazz beyond its current form. My project is not merely trying to add something to the art form, I am rather arguing for an extension of the jazz ecological conditions through a careful application of the symbiotic relations within the art form into a new medium. The prior chapter sought to characterize performers as experiencing-agents in order to model audience interactivity on the interactivity among musicians—to align potentials for action presented to the audience with intentional flows by musicians in performance. Since jazz audiences have historically been much more interactive in the past, I would suggest that extending the jazz ecology to include audience interactivity through mobile devices, if successfully modeled on performance action, may re-open an aspect of the historical jazz ecology that has become relatively closed.

The challenge lies in extending the interaction design of jazz performance to a new or emerging technology design. How do we "evolve" the techne of jazz in a way that extends and emerges within the past human-technological symbiotic relationships created in it? In the prior chapter, we saw some important features of what jazz musicians do and how they do it. If we are to extend the ecology of performance actions in the audience, the challenge arises in knowing what an audience should do and how they should do it. Knowing what to do and how to do it is a problem of practical knowledge. The solution will involve deriving ends sought by audience interaction from ends sought by a jazz ensemble.

As was argued in Chapter 2, all practical knowledge begins with the end in mind, an end that begins but is set off to the side of a practical syllogism expressing the logic of that action. A jazz musician will begin an improvisation with an end in mind. That end could be to maintain the parameters of groove and harmonic rhythm, it could be a certain note, a style of play, the desire to improvise around the chord changes in counterpoint to the soloing musician, etc. The ends sought by a jazz improvisation may be multiple. Some of these ends are relatively constant: to play the

song that was called, to maintain the parameters, to follow the head-solo improvisation-head order of play. But other ends are shifting, evolving in snatches and generally difficult to pin down in performance. Thus, we face the challenge of effectively extending the jazz ecological context to include potentials for action for audiences when the ends of performance are not always clear or pre-defined.

I will propose a solution to this challenge beginning with a design principal developed in artificial intelligence called ecological balance. The principal of ecological balance proposed by Pfeifer and Bongard in *How the Body Shapes the Way We Think* is meant to demonstrate how to balance the physical construction and directive control of an artificial intelligence with the particular ecology in which it is supposed to function.[301] In effect, much of the cognitive load involved in interacting with a particular ecological context is distributed through designed, body-ecology relational constants. While the potential ends sought by an artificial intelligence, the objectives in movement, might be exponentially numerous and require significant cognitive load if each movement needed to achieve those ends had to be individually calculated, the execution of those ends is greatly simplified by distributing cognitive load throughout the designed body-ecology relational constants explained by the principal of ecological balance.

Ecological balance has been applied in robotic design to create robot-ecology symbiosis through causal relations between the body architecture of the robot and the ecology within which it operates. This specific application of the principal of ecological balance is called passive-dynamic design. For reasons that will become apparent later in this chapter, it is important to point out that these causal relations are based on post-Humean causality, the event-causality we usually think of when we envision billiard balls colliding.

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[301] Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 124.

While Pfeifer and Bongard apply the principal of ecological balance and passive-dynamic design to the creation of artificial "agents" that will function within a specified ecology, my design project seeks to extend the interactivity of an ecology, creating additional potentials for action for fully-functioning agents within the ecology. This difference might give pause to my use of the principal of ecological balance. However, ecological balance clarifies my project because it describes important principals of how bodily behaviors, the intentional traces of action in the world, occur through a body-world symbiotic relationship. Passive-dynamic design specifically provides a foundation for the design of ecologically balanced bodily behavioral in the world, but this foundation must be translated if it is to serve in the design of an interactive ecology that provides affordances for actions and interactions among agents. This translation, I propose, should be called passive-dynamic interaction design. The key function in this translation turns upon a recognition that Cartesian causality is an insufficient basis for describing the actions of free agents within a given ecology. Aristotelian causality provides a much stronger basis for understanding agent-ecology relations for the purposes of interaction design.

In what follows, I will further explain my translation of the principal of ecological balance into passive-dynamic interaction design. I will then provide an outline of the design of the Nymbus platform, and will conclude with an explanation of how the platform is designed according to the principals of ecological interaction design, looking at each of those principals in turn.

4.1 PASSIVE-DYNAMIC INTERACTION DESIGN: THE PRINCIPAL OF ECOLOGY AND ARISTOTLE'S FOUR CAUSES

In *Supersizing the Mind*, Andy Clark examines two differing paradigms in humanoid robotic design. The first design paradigm, exemplified by Honda's Asimo robot, solves mobility and dexterity challenges with impressive joint and limb control and range of movement. Tellingly, the moniker Asimo is an acronym of Advanced Step in Innovative Mobility. Asimo has 26 degrees of movement divided between the neck (2 degrees), arms (6 degrees each), and legs (6 degrees each). This results in a robot that can among other things walk around a room, climb and descend stairs, grasp objects.[302] However, Clark explains that the scale of energy consumption per unit of weight per unit of distance carried (specific cost of transport) vastly exceeds that of natural, human walkers. A lower specific cost of transport equates to lower energy consumption. The intensive energy used to monitor and manipulate Asimo's joints results in very low energy efficiency. Clark explains that "Asimo rumbles in with a specific cost of transport of about 3.2, whereas we humans display a specific metabolic cost of transport of about 0.2."[303]

The second design paradigm examined by Clark, passive-dynamic design, much more closely approximates the efficiency of human movement. Passive-dynamic walkers "…make maximal use of the mass properties and biomechanical couplings present in the overall musculoskeletal system and walking apparatus itself."[304] Rather than relying on extensive planning and precise control of joints and limbs, passive-dynamic walkers rely on structural

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[302] The robot can also recognize faces and voices, but that beyond my main point. Clark, *Supersizing the Mind*, 3.

[303] Ibid.

[304] Ibid., 3–4. See also, McGeer, "Passive Dynamic Walking."

balance, mechanical linkages between joints, and use of the natural, swinging pendulum motion of limbs. These simple, internal controls (parameters) of movement are coupled with feet curved and padded to match the rising/falling pendulum motion and the surface upon which they walk. The resulting movement of passive-dynamic walkers has been described as "steady" and "graceful." Early versions of passive-dynamic walkers were children's toys that required minimal activation—a gentle inclined walking surface or tug on a string attached to the toys would set them in motion. Later versions of dynamic-passive walker activation and control conserve energy by "…systematically, pushing, dampening, and tweaking a system in which passive-dynamic effects still play a major role."[305] As is evidenced by the low specific cost of transport, passive-dynamic walkers provide a much closer approximation of natural, human walking in comparison to Asimo.

Dynamic-passive design has been contextualized within a larger framework for the design of autonomous, real-world agents by Pfeifer and Bongard.[306] The impetus behind this larger framework arises out of a desire to conceptualize intelligent agents in more than merely psychological terms. Pfeifer and Bongard introduce this framework with a brief discussion of what we know of intelligent agents and how they function in the world.[307] Their observations are helpful and many apply to the theory of action already discussed in this dissertation. So I will give a brief overview of these points here. First, Pfeifer and Bongard examine some constants that apply to autonomous agents by virtue of their placement in a physical world. Then, they provide insights into the way that the bodies of agents function within those physical, real-world constants. Then they combine these constants and functional regularities to design principals.

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[305] Ibid., 5.
[306] Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence.*
[307] Ibid., 91–92.

4.1.1 Agents Within Real-World Constants

Real-world agents display a level of autonomous self-control. Autonomy can be difficult to define and is a degreed property of agents, but real-world agents display a relatively high degree of self-monitoring control of their own behaviors. Passive-dynamic walkers are autonomous in their steady, graceful traversing movements, but this is a relatively low degree of autonomy. They are able to move without the direct intervention and manipulation of their joints by a controller exterior to their walking system. However, they do not choose when and where to walk. They must be placed on an incline or pulled with a string. In both of these cases, the goal or end of their movement, is determined by a truly autonomous agent who is not part of their interior movement controlling design. Agents with greater autonomy have the capacity to form goals and plans and then execute them through self-monitoring and sustaining processes.

Real-world agents also have bodies with which they interact with the world. Consequently, sensing within an environment, forming perceptions about the environment, and performing actions all take time. I showed in Chapter 2 why temporality is a central feature of Anscombe's conception of practical rationality. It also formed a key component to one of her arguments against Donald Davidson's belief-desire causal thesis. Beliefs and desires, being states, do not take time, which leads to conceptual difficulties as causes of action.

Real-world agents also face constraints on perceptual function. Because they have bodies interacting within an enveloping environment, they will always remain limited in the amount and quality of information that they may have about their environment at any given moment. With eyes positioned in the front of our head, we cannot see behind us, and a dense fog will obstruct what we can see within our field of vision. This point explains in part the emphasis of action on

our perceptual processes discussed in Chapter 3. We act within a given ecology often to gain perceptual information that may be obscured yet indicated by other perceptions.

Even for perceptions of relative completeness and little distortion, real-world experiences are always ambiguous. While computational systems may clearly define "states" within computational operations, real-world agents must differentiate between an act within a broad continuum of similar experiences. For example, both Anscombe and Pfeifer and Bongard examine the multiple considerations that may precede a decision to grab an umbrella when going out for a walk on an overcast day.[308] Is it in fact raining? How much? And is it likely to stop? What are my objectives for going out? Perhaps, an umbrella will constrict my movement in a crucial way, whereas a raincoat would not.

Real-world agents often hold a multiplicity of objectives among which they must place various values and orders. The jazz ensemble, I argued, makes performance choices based on a hierarchy of values. Maintaining the head parameters, for example, is crucial to the cohesion of the ensemble and will frequently direct the attentional focus of musicians when the group begins to loose clear sight of these parameters.

Finally, real-world agents operate within constantly changing environmental conditions. Consequently, the capacity to quickly detect these changes and modify prior plans and objectives is crucial to the daily functioning of autonomous agents. This capacity lies at the heart of a jazz improvisation not only for comping musicians, but also for soloists. Hodson provides a compelling analysis of a dynamic shift in Cannonball Adderley's improvisation in "Groovin' High" in response to accompanist Wynton Kelly's blues voicing of the harmonic rhythm. Hodson writes that,

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[308] Anscombe, *Intention*; Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 92.

> Kelly's strong, bluesy voicing…seems to have a galvanizing effect on the performance. It's almost as if Adderley hears this chord, draws upon the knowledge of jazz style he shares with Wynton Kelly, realizes that this harmonic configuration signifies the blues style, and responds to Kelly's assertion by continuing his improvisation in a blues idiom.[309]

These properties of real-world agents outlined by Pfeifer and Bongard pertain to what it means to be "in the world." Pfeifer and Bongard next examine functional regularities of "complete agents" in the world. Most of these properties are hinted at in the above paragraphs, but I will list them briefly, and then turn to the design principals that are derived from these observations.

4.1.2 The Bodily Constants of Agents

In conjunction with properties of the real-world faced by autonomous agents, Pfeifer and Bongard identify five bodily properties of autonomous agents. Briefly stated,

1. *They are subject to the laws of physics* (energy dissipation, friction, gravity)
2. *They generate sensory stimulation* through motion and generally through interaction with the real world.
3. *They affect the environment* through behavior.
4. *They are complex dynamical systems* which, when they interact with the environment, have attractor states.
5. *They perform morphological computation.*[310]

The first three of these properties do not need to be discussed here, but the last two are notable. I can hardly introduce key concepts in dynamical systems theory in this dissertation, but it might be helpful to briefly mention some of the points on dynamical systems covered by Pfeifer

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[309] Hodson, *Interaction, Improvisation, and Interplay in Jazz*, 8.

[310] Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 95. italics theirs.

and Bongard. Dynamical Systems Theory (DST) has been used to analyze the function of a variety of differing types of animal bodies.[311] While the human physical system includes numerous variables like the angles of joints and heart rate, the way that those variables function in coordination with one another can be mathematically modeled in a set of differential equations that includes those variables. Dynamical systems are non-linear, and as a consequence if the same system is set in motion from nearly stable initial conditions, it will quickly reach differing end-states across a number of "trial runs." Yet, despite this relative irregularity, dynamical systems will nonetheless fall into what are called "attractor states" due to the finite set of values that each of the variables in the system may assume. There may be a number of attractor states for any one dynamical system; each state has its own "basin of attraction" within which the system will begin to seek the attractor state of that basin. Pfeifer and Bongard explain this in reference to the walk, trot, canter and gallop of a horse. The horse, they observe,

> …is always in one of these states, except for short periods of time when it transitions between two of them, for example from canter to gallop. We should point out here that the attractor states into which an agent settles are always the result of the interaction of three systems: the agent's body, its brain (or control system), and its environment.[312]

Horses are mechanical systems, at least in the terms that Pfeifer and Bongard talk about them here. Jazz ensembles are not mechanical systems, but a jazz ensemble nonetheless relies on something very like an attractor state. For example, in a jazz quartet the notes played by the bass are variable, but there are a finite number of notes that may be played on a bass of standard tuning and bassists will usually play notes that fall somewhere in a "basin of attraction" defined by the head's harmonic progression. Of course, the human playing the bass can always choose to play

[311] This large field has been applied to many other types of systems beyond animal bodies, but I am focusing on action, which occurs through animal bodies.

[312] Ibid., 96.

something harmonically foreign to the head arrangement, but usually they find these harmonic parameters helpful in guiding their improvisational accompaniment of the soloist. Similarly, a drum kit may be played at a finite number of beats per minute (by a human) and any given drummer will know a finite number of grooves. The drummer in conjunction with the bassist will fall into a groove and regular rhythm within these variables. As intelligent agents leverage the regularity and self-regulation of the dynamical systems that generate their movement, jazz musicians leverage harmonic and rhythmic regularities to lessen the cognitive load of an improvisation. Similarly, I examined in the prior chapter how the instrumentation in conjunction with the head arrangement parameters are used to establish patterns of interaction between members of a jazz ensemble that lighten the cognitive load of improvising musicians. While some of these dynamics of a jazz ensemble arise out of its systemic properties, such as the roles assigned to each musician in regard to the parameters, others are better attributed to its formal makeup, its morphology.

As seen in point five above, Pfeifer and Bongard argue that complete agents leverage their physical morphology in relation to their environment to lessen cognitive load on their control system. They state that,

> Complete agents perform morphological computation. By "morphological computation" we mean that certain processes are performed by the body that otherwise would have to be performed by the brain. An example is the fact that the human leg's muscles and tendons are elastic so that the knee, when the leg impacts the ground while running, performs small adaptive movements without neural control. The control is supplied by the muscle-tendon system itself, which is part of the morphology of the agent.[313]

From these features of complete agents in relation to their ecological niche, Pfeifer and Bongard derive a set of seven design heuristics. These heuristics are not meant to function as tightly interlocking principals or theoretical system upon which to base the design and construction

[313] Ibid.

of artificial intelligences. The world is too chaotic and the objectives of agents too diverse. Complete agents must be flexible and adaptable. Hence, design heuristics, or principals, are needed rather than a systematic theory.[314]

4.1.3 Design Principals: Ecological Balance and Aristotle's Four Causes

Pfeifer and Bongard derive seven design principals from these environmental and bodily constants of complete agents. Their design principals are immensely interesting. However, Pfeifer and Bongard are theorizing the design of "complete agents," but I am seeking to extend potentials for action within the jazz performance ecology in which agents perform. Consequently, I will focus on their sixth principal of Ecological Balance (EB), which directly pertains to the interactive relationship of agents in the world. Pfeifer and Bongard state:

> The principle of ecological balance has two parts. The first states that given a certain task environment, there has to be a match between the complexities of the agent's sensory, motor, and neural systems. The second aspect is closely related to the first; it states there is a certain balance or task distribution between morphology, materials, control, and environment.[315]

The first aspect of EB pertains to balance among the various faculties of the organism itself. For example, a snail would not benefit from enormous eyes; they would in fact inhibit the snails movement and the capacity to clearly make out visual details of objects miles away would hardly benefit a slow-moving snail.[316] Humans need to be able to pick out fast-moving objects in detail at a distance due to our particular mode of life; snails do not. There is much that can be useful to human-centered design to be gleaned from detailed study of the "…complexities of the agent's

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[314] Ibid., 100.
[315] Ibid., 123.
[316] Pfeifer and Bongard take this example from Richard Dawkins *Climbing Mount Improbable.*

sensory, motor, and neural systems." But an essential aspect of this study pertains to the function of the agent within an environment. Hence, the close connection between the first and second aspects of EB. I am not designing the sensory, motor, or neural systems of agents; I am rather designing tools and ecological context in which those systems operate. Consequently, the second aspect of EB is of greater relevance to my project.

Ecological Balance seeks to distribute the cognitive and manual work required to perform a certain task, reach a desired goal, between the agent in relation to the world. Implicit within this principal is the idea that agents have certain tasks or objectives that they seek to accomplish within a particular environment. The particularity of these tasks has affected the evolutionary development of the agent's sensory organs, body materials and morphology, and neural control systems. The result is that the demands of achieving these goals in relation to the physical environment is distributed between the senses, the body, and the control system.[317]

Pfeifer explains the sensory aspect of this principal in the way that an insect eye receives stimulation when in an avoidance course relative to a stationary object.[318] For example, in order to survive, a fly must track and avoid objects during flight. Rather than accomplish this task through complex spatial calculations, the fly is imbued with multi-faceted eyes that allow it to take advantage of naturally occurring parallax in its changing relationship to stationary objects during flight. If the fly is headed directly toward a tree, the tree does not appear to be moving. But if the fly shifts course slightly, then differing facets of its eye will begin to sense the tree in succession. As the fly approaches the tree, its shifting from facet to facet will naturally speed up if each facet has the same dimensions. However, eye facets in insects are not uniform. Instead, they are narrower

[317] Pfeifer, "On the Role of Morphology and Materials in Adaptive Behavior," 2000.
[318] Pfeifer, 2000, 27.

(closer together) toward the front and rear of the eye (with an eye placed on the side of the insect's head), and wider (further apart) toward the middle of the eye. Consequently, a straight line of flight in relation to a stationary object appears to the insect as a constant and fluid movement of that object through their field of vision. In effect, parallax is perceptually eliminated for the insect when it is flying a straight, avoidance course in relation to a stationary object.

Pfeifer demonstrates that similar design features in the placement of differing types of sensory preceptors (touch and sight, for example) can create sensory redundancy that lessens cognitive load on the organism's control center. Similarly, the materials and morphology of limbs can aid in their function. Tendons, soft materials covering extremities, and slack in the joints can resolve control problems and facilitate greater adaptability.[319]

Pfeifer and Bongard apply this principal of Ecological Balance to the design of robots and artificial intelligences, but EB only works in the relation between an embodied "agent" and its environment. If the multi-faceted design of the an insect's eyes only works to eliminate the perception of parallax when the insect is in a world in which certain laws of physics apply. Similarly, morphologies and material construction of limbs that facilitate climbing or bounding on hard surfaces will have little effect (and probably reverse effect) in quicksand. This is why first part of EB focuses on the sensory, motor, and neural systems of the agent, while the second part of EB focuses on "…morphology, materials, control and environment." When seeking to explain the natural phenomenon of the flight of an insect, we cannot merely look at the internal systems of that agent, instead we must look at its form, materials, and control in relation to the environment because the significance of that design only emerges when placed within the context of the action in an environment. Looking at an agent's body, we will not ascertain its function apart from an

[319] Ibid., 29–30.

imagination of the context in which it lives. This is because action is more than merely the sum of the agent's movements. When a roboticist seeks to design a robot, she must ask what it is that the robot is to do, what it seeks and where it seeks it. Only then can the first part of EB be put to use. Frederic Stoutland summarizes this point in Anscombe's philosophy of action:

> …to exercise that power [of action] is not primarily to cause events outside one's body; it is to perform actions that extend beyond one's body and its movements. Walking, running, eating, drinking, pounding, skiing, greeting, writing—ordinary bodily activities all—do not consist of bodily movements plus events they cause; they are our moving our bodies in ways that extend beyond them. We can run or walk only on a surface, that is, only in a world outside ourselves that also acts on us. We can eat or drink only by eating or drinking something that is edible or drinkable. To use a hammer is not to cause it to move, and to ski is not to cause skis to move: those are extended bodily movements. All these bodily activities require that the bodily movements occur as constituents of a structured activity that is more than the sum of the movements.

Similarly, we can sing a sonata or improvise on a melodic structure only in a world in which such things exist.[320]

The first part of EB focuses on the internal systems of the agent, but in the second part of the principal, Pfeifer and Bongard focus on the idea of "balance or task distribution." Their use of "balance" appears to mean a distribution of cognition between the agent, the world, and interaction between the two. It seems that this reading of "balance" would require a strong conception of extended cognition; this is, after all, a balance between materials, morphology, and environment along with "control," which Pfeifer defines as the neural circuitry of the agent.[321] I do not believe that I need to delve into arguments pro and con extended cognition. Rather, I would merely point out that whether or not extended cognition holds up as a philosophy of mind, Anscombe has pointed to a certain logic in the physical structure of actions. At a minimum, it seems that Pfeifer

[320] Perhaps in the domain of human, artistic endeavor, I should say "…only in a world where such things can be imagined." But even this depends on a world with certain acoustic and harmonic properties.

[321] Pfeifer, "On the Role of Morphology and Materials in Adaptive Behavior."

and Bongard's idea of balance refers to an agent's cognitive leveraging of the physical constants in the relation between their bodies in motion and a physical environment. Because the motions of bodies are of specific interest when those bodies are doing some *action* about which the agent has some vested interest (as opposed to merely uncontrolled movement), we can reasonably argue that "balance" within the principal of Ecological Balance refers to the reason implicit in *doing some action*. This is in part because of the physical makeup of the agent's body and in part because of the world and in part because of the relation between the two.

Consequently, while EB can be highly instructive to the design of agents, it can also be applied to the design of interactions within an existing ecological context by agents. However, in order to function as a principal of design for actions, EB must be "translated" into the action paradigm already outlined in this dissertation. I will briefly make this translation in the next section and then turn to its application in the Nymbus platform.

4.1.4 Ecological Balance and Aristotle's Four Causes

Andy Clark and Pfeifer and Bongard examine passive-dynamic design and the broader principal of Ecological Balance in relation to the design of robots and artificial intelligence with specific objectives. In addition to the unique conceptualization of sensory experience that arises out of EB, these authors emphasize the efficiency of control and behavior brought about by passive-dynamic design and EB. For example, passive-dynamic walkers achieve natural and graceful gait by their particular body morphology. Similarly, Pfeifer and Bongard discuss the design of a quadruped robot, "Puppy," that uses sprung legs and a flexible spine to effectively overcome the difficult

robotics problem of running.[322] Another robot discussed by Pfeifer and Bongard, “Kismet” from the MIT Artificial Intelligence Laboratory uses a parallel coupling of visual focus, object-tracking, sound localization, and habituation avoidance (boredom) reflexes to respond and interact with changes in its environment.[323] Kismet's reliance on coordination of ecology and behavior across various sensory modalities effectively conveys attention and response to human interactors.

While these robots brilliantly display the effectiveness of passive-dynamic design and EB at varying levels of sophistication, they all presuppose a certain purpose or objective that guides their movements and determines their success or failure. For example, in the case of Puppy, success is defined by the robot's ability to effectively run and scramble over slippery surfaces. This objective directed the roboticists' choice of form, material, and directive control when designing Puppy according to the principals of Ecological Balance. While certain morphological and material choices may yield surprising results, for example, smooth metal feet on Puppy enabled it to respond better to slippery surfaces in the environment, the value attribution of “better” appeals to pre-defined objectives held by the roboticists.[324] If the human purpose in building the machine was to plow up the surface, then quickly traversing over it would in fact be a design flaw; material, form and directive control would need to be altered so that it matched the desired outcome of the robot within its environment.

Similarly, if the MIT Lab wanted a robot that could register but ignore new environmental stimuli while maintaining focus on a particular object within its visual field over long periods of time, then Kismet would have been a failure. These observations do not lessen the significant

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[322] Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 96–100.
[323] Ibid., 136.
[324] Pfeifer and Bongard confirm this point on Ibid., 138.

accomplishments in the design of these robots. Rather, they merely reveal the "hidden" objectives within these robot designs.

Pfeifer and Bongard, address the importance of "values" in their eighth principal of complete agent design. Their value principal states that "…intelligent agents are equipped with a value system which constitutes a basic set of assumptions about what is good for the agent."[325] They go on to explain that,

> The value principle [is] on the one hand very important because it deals with the fundamental issue of what is good for the agent, which then leads to the question of what the agent will or should do in a particular situation. On the other, the value principle is also extremely vague, and there is no consensus in the vast literature about how to approach it, neither in biology and psychology, nor in robotics and artificial intelligence. So, we cannot provide a satisfactory answer.[326]

Ecological Balance and passive-dynamic design are important, but only in so far as one knows what the thing designed should *do* within an ecology. Or said differently, ecology matters only in relation to the "Why?" of the agent, which is a question that humans ask when they are working in the realm of practical rationality or discerning the motivation *with which* an agent acts.

It will be recalled from Chapter 2 that the Aristotelian conception of action also addressed this problem of the end that is sought in action. Ultimately, an agent's final end is discerned through the particular intellectual virtue of *phronesis*, practical wisdom. But that end is also in part discovered by the study of the agent—a discernment into that which allows the agent to function flourish. Friendship, for example, is one of the most notable goods that Aristotle determines to be essential to human flourishing. Those actions which seek the end of friendship are good insofar as they achieve this good.

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[325] Ibid., 137.
[326] Ibid.

Within the sphere of human accomplishment and aspiration, there exists an immensely complex web of perceived goods that guide action. Fortunately, I have not embarked on the project of mapping that web. Rather, my modest goal is merely to expand the potentials for audience action within jazz concerts. Approaching this goal is much more manageable in large part because the actions and values of jazz performance are already substantially prescribed. Of course, jazz musicians may play outside of the parameters and bend the rules. New sub-genres of jazz are thus created. Humans may, generally speaking, do whatever they like. I am not concerned with all of these potentials for action; rather, I am considering something specific that we know that humans like to do: play and listen to small ensemble jazz as described in Chapter 3.

Just as a child who has been given a passive-dynamic walking toy can begin to understand what to do with it by observing closely its parts, the interactions between the parts and its behavior when placed in various settings, so also we can in part discern what an audience member should do in response to jazz by observing its parts and behavior within the ensemble in a particular setting. A child who has discovered that her passive-dynamic walking toy will successfully totter down an incline on its own may decide to attach a string to it and tug it around the house. *Why* the child arrives at this goal is in part due to her own creativity, but it is also importantly due to her observation of what the toy did on the incline by virtue of its design. The child may do many things with the toy. She may place it in a fire and watch it melt. Perhaps the melted toy presents other potentials for play. But taking the toy for a stroll about the room is an end derived from the materials, morphology, control mechanisms and ecology of the toy's original design.

Consequently, when it comes to action and interactivity, we can see that knowing what to do with something can in part be derived from its materials, shape, controls or capacity for manipulation within defined limits, and its environment. We would not consider these things causal

factors today, but in the ancient world, they were often considered to be the causes of the object. Aristotle was not the first person to study these causes; others before him had attempted to explain why things exist in terms of their causes.[327] But Aristotle presents a unified theory of four differing types of causes: material, formal, efficient and final. What is remarkable is that the first three of these causes map very well onto the second part of the principal of Ecological Balance, which focuses on morphology, materials, control and environment.[328] This correlation between Aristotle's causes and EB requires a bit more detail.

Aristotle defines and defends the Four Causes in *Physics* II 3 and *Metaphysics* V 2.[329] Causality is a highly difficult concept to define, but since Hume's *A Treatise of Human Nature* and *An Inquiry into Human Understanding*, we tend to conceptualize causality in terms of event-causation, or causes in relation to effects. Aristotle's four causes explicate causation in terms of an explanation of a substance's existence. As Aristotle states, "…we do not believe that we know each thing before we can grasp the "why" of it…."[330] Thus, explanation, an answer to the question "Why?" is central to Aristotelian causality, but he does not characterize the answer to that "Why?" in terms of propositions. Rather, this "Why?" is expressed in terms of natural change, and this is where he arrives at four causes—the four interlocking components to natural change. Briefly stated the four causes are as follows:

1. The Material Cause: "…that from which…something comes to be." A bronze statue is what it is in part because of the existence of bronze.

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[327] Falcon, "Aristotle on Causality."

[328] The reader will recall that in the prior section, I argued that this second part of EB is of central importance for its linking of the agent to action within an ecology.

[329] Aristotle, *Physics*.; Aristotle, *Metaphysics*.

[330] Aristotle, *Physics, Or Natural Hearing*, 194b16.

2. The Formal Cause: the form or pattern that expresses the essential formula by which the thing exists. The form also expresses the classes or genera of that formula and includes the parts that comprise it. For example, the ratio 2:1 is the formal cause of the octave. Likewise, the shape of a statue is its formal cause.
3. The Efficient Cause: the "source of the first beginning of change or rest…" The musician who plans an improvisation is the efficient cause of that improvisation. Commentators point out that Aristotle refers to the art of the artist as the efficient cause. However, it has been a recurrent theme throughout this dissertation that "art" refers to practical knowledge, which differs from theoretical knowledge in its' essentially enactive capacity, and action requires an agent.
4. The Final Cause: "…'that for the sake of which' a thing is done…" In this sense, health is the cause of exercise, but health is also the cause of all the individual steps needed to bring about its completion. The end of health is the final cause of not only the activity of exercise but also the instruments (weight machines, yoga mats, running shoes, etc.) that are part of its completion.

From this description of the four causes, we can see a fairly direct mapping of the first three causes onto the second half of the principal of Ecological Balance. The mapping occurs as follows:

Principal of Ecological Balance	:	**Aristotle's Four Causes**
Agent Material	:	Material Cause
Agent Morphology	:	Formal Cause
Directive Control	:	Efficient Cause

Perhaps the lack of the final cause is most conspicuous about this mapping. The mapping also appears to fail to account for EB's emphasis on materials, control and morphology *in relation to an environment*. In fact, these two apparent lacunas within the mapping are one and the same

thing. Within EB, the importance of materials, morphology and control in relation to the environment pertains to the particular function of the agent within that environment, which as was argued above, references preconceived values of the designers implementing EB in the design of the agent. Similarly, the final cause references the "end" of the agent, which within virtue ethics provides the locus for determining and structuring a hierarchy of values. Therefore, we could map the final cause onto EB as follows:

Materials				
Morphology	vis-à-vis	Environment	:	Final Cause
Control				

The importance of the "vis-à-vis" between Materials, Morphology, Control and Environment lies in the action of the agent designed according to the principal of Ecological Balance. This action is what the agent is to *do*, an issue of practical knowledge. But Practical Knowledge requires that we identify the agent's End, which is where Pfeifer and Bonnard's Value Principal becomes necessary. In a very real sense, designing an agent, or designing actions and interactions requires a knowledge of the end sought, the final cause, which is difficult to identify.

However, the four causes are all interdependent in important ways. Philosopher Sarah Broadie, for example, points out the absurdity of conceiving of a Final Cause in a vacuum. She states, "But in Aristotle, final and efficient causality are complementary: the end is an end of or for an agent, and the agent as such is bent on an end."[331] Thus, while we may not know what an agent should do (its end in a given situation), we can make a fairly good guess by studying the agent and the situation. In robotics, the roboticist should have a fairly solid handle on the end

[331] Broadie, *Aristotle and beyond*, 87.

sought, the Final Cause. For my purposes and the purposes of interaction designers in general, understanding and extending interactions can be facilitated through a careful study of materials, morphology and control vis-à-vis the environment.

In the prior chapter, I mentioned that while the jazz ecology presents a musician with certain parameters, it *underdetermines* the actions that the musician may pursue. This enables improvisation. The challenge for the musician lies in determining what to play, how to improvise. Looked at another way, we could listen to a jazz improvisation and then ask why the musician played what she played. As was argued in the first chapter, the answer to this "Why?" will reveal the teleological structure, the intentionality, within the act of improvisation. Since the end of an act is discoverable in the means by which it is performed, at least in part, the teleology of means also points toward the end sought in improvisation.[332]

I have discussed how jazz improvisers will cite a variety of reasons, answers to the question "Why?" for improvising in a certain way—to play in a particular style, to end on a particular note, to imitate an animal or street sound…. These ends frequently emerge out of the parameters established in the head and main melodic line. They also emerge out of the dynamics of the ensemble and out of the dynamics of the venue in which the ensemble plays—what the improvisor just played, what other members of the ensemble played in response to what he just played, who may have just walked in the door of the venue, etc.. Thus, by attending to the parameters of performance within a social and cultural context, we can provide reasoned answer to the question

[332] The revelation of the end in the means should not overlook the important point that means may be pursued to achieve one or more ends, and the expanded description of an action always leaves open the possibility that the end is not conceptualized solely in terms of the means used to achieve it.

"why?" of a jazz improvisation. If this is not a complete answer to why the improvisation occurred as it did, it is at least a very good start.[333]

The principals of passive-dynamic design examine the intentionality of bodily behavior in its material, efficient, and formal causal features in relation to a given ecological context. Passive-dynamic design is applied in the design of an "agent." I have argued that we can just as validly examine these features of existing bodies in action to derive extensions of those actions. We can begin to understand jazz musicians on the stand by examining the material, efficient, and formal causes of their actions within their ecological context. By doing so, we begin to comprehend the action of jazz through its intentional flows. We can then match our extension of the potentials for action and interaction within that context by attending to the formal, material and efficient causes within our design. This is the structure of the next section on the Nymbus platform. I will first provide an overview of the platform, and then break down its design components into material, formal, and efficient causes in relation to the ecological context of jazz.

4.2 DESIGNING THE NYMBUS PLATFORM FOR INTERACTION IN LIVE JAZZ CONCERTS

I must begin the consideration of the design of the Nymbus platform for audience interactivity by recognizing the vast potential and also the limitations that emerging technology brings into an

[333] This argument is supported by the musicologists I have used heretofore: Monson, *Saying Something: Jazz Improvisation and Interaction*; Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*; Hodson, *Interaction, Improvisation, and Interplay in Jazz*.. It also finds significant resonance in the idea of an "attractor state" in dynamical systems theory. See, Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 94.

existing performance ecology. These limitations and potentials come in two varieties. First, I must place reasonable limits on the range of technologies that are considered. This is not because certain technologies should be eliminated as unsuitable in principal. Rather, for considerations of time, I cannot consider every technological integration possible. Second, within the sphere of considered technologies, I must adequately understand the potentials and limitations of each technology.

First, I will limit the scope of technologies considered and give some reasons for these limits. I could approach the challenge of technologically equipped audiences from a very broad perspective, opening the study to the incorporation of *any* new or emerging technology into a performance space. Recently, heads-up displays, such as Google Glass, and unmanned aerial vehicles, commonly know as drones, have emerged in public consciousness and have become relatively affordable. We could study the design of a system that combines drones buzzing about a jazz ensemble beaming a live video feed to audience members wearing heads-up displays. A current project at the University of Pittsburgh does in fact focus on the use of Google Glass to give audience members an on-stage view of the action or alternately to aid hearing-impaired audience members during live performances.[334] The project leaders have also considered using Glass to improve communications within the performance technical running crew.

Similarly, extensive research and development of environmental sensors is underway throughout out academia and industry. Highly sophisticated sensors of various types are increasingly embedded in more spaces and physical objects as part of the quickly emerging "internet of things." We could devise sensor-rich performance spaces that provide audiences with detailed knowledge of a performer's actions and perceptual focus. Give the rapid expansion of new technologies today, the possible changes that can be introduced to a performance experience are

[334] This project focuses on live theatre performance, not jazz.

vast; some reasonable focus and limitations should be established. Part of the purpose of this dissertation is to provide performance practitioners with the conceptual tools needed to consider the options and focus their efforts.

Nymbus focuses on the use of smartphones by audiences. Several reasons for this focus are relevant. This focus keeps the discussion within the domain of popularly adopted "Ubiquitous Computing."[335] Holograms are quite interesting and could present audiences with unique experiences, indeed they currently are used for that purpose. However, given the controlled environment needed for their success and the technical skill needed for their deployment, they have not (yet) become ubiquitous. The focus on ubiquity simultaneously limits the technological playing field and focuses it on computing that is already beginning to shape the way that audiences experience life on a daily basis.

While smartphones significantly focus the technologies considered, they can also efficiently facilitate complex interactivity on a more-or-less broad scale within live performance without incurring significant expense to performing arts organizations. There are a number of new companies that provide audience "interactive" technologies that are nonetheless highly limited in their interactive potential. Glow Motion, for example, builds LED light-up wristbands (and other accessories) that audiences can wear during a live event.[336] The company claims that the lighting effects are "100% Interactive." The effects that can be created by Glow Motion are quite impressive, but the wristbands face limitations in the spectrum of data that can be communicated to and from the wristbands. A performing artist can make the wristbands light up on cue in a variety

[335] Ubiquitous Computing is a term that has come to refer to computing that can occur anywhere as opposed to computing tied to single physical location (e.g. a desktop computer). Ubi. Comp. relies on a variety of technologies: devices, sensors, protocols, operating systems, etc., many of which are not popularly adopted as are smartphones.

[336] Glow Motion, "Glow Motion Technologies Homepage." For other examples see: PixMob, "PixMob Homepage."; Xyloband, "LED Wristbands and Wearable Technology Products."

of colors and flash/fade speeds and the audience can manipulate their personal wristbands light effect through movement. A single wristband in the audience can even be triggered to become a focal point around which other wristbands in near proximity light up. However, triggering the wristbands relies on a limited radio frequency communication protocol. The wristbands may be activated in real-time in a variety of configurations, but each wristband is limited to lighting up and transferring limited information to the server and other devices (such as a unique identifier). The wrist bands may be 100% interactive, but only along a highly limited spectrum of interactivity determined by the capabilities of the wristbands. Smartphones have much greater potential for interactivity at a cost similar to cheaply manufactured LED wristbands. This brings the discussion to the second point: the potentials and limitations of smartphones in performance spaces.

Phones have become laden with a variety of sensors, input interfaces, and haptic feedback capabilities. Furthermore, with the recent introduction of wearables (particularly smart watches) into consumer markets, the sensors, interface, and haptic feedback capabilities of phones are expanding. Apple Computer's recently released Apple Watch includes a specially designed “Taptic Engine” that allows Apple Watch wearers to get one another's attention with a gentle tap on the wrist. Or alternately, since the watch also monitors the wearer's heart rate, the Taptic Engine allows wearers to “…send something as personal as your heartbeat.”[337] I would imagine that performance artists could devise something less startling (or perhaps merely more interesting) than send heartbeats to fellow Watch wearers. The potential is intriguing, and when coupled with the accelerometer of smart watches, provides compelling reason to focus design efforts for live performance on smartphones.

[337] Apple Inc., “Apple - Apple Watch - Technology.”

Smartphone accelerometers can sense multiple directions of movement, which can determine not only phone orientation, but also motion, tilt, shock, and vibration. A phone's gyroscope can measure the velocity of change within these vectors of movement. Phone proximity sensors can collect data about the current use of the phone relative to the person using it. Ambient light sensors are also common. Beyond these less obvious features of contemporary smartphones, most people are well aware of the capabilities of the screen for user input, LED flash, camera functionality, global positioning for location-based functionality within 20 to 30 meters, microphone, Bluetooth, Wi-Fi and cellular connectivity.

These capabilities are impressive and under constant refinement and expansion. Smartphones present designers with a wealth of capabilities. However, since live performances are collective experiences, designers should be cognizant of the fact that this list of features changes and not all phones include all capacities. For example, Bluetooth v4.0 introduces protocols that leverage new hardware to enable fast Bluetooth connections between devices. Bluetooth v4.0 could therefore possibly be used to create a network of phones in the audience, which could be used to map the locations of each audience member and facilitate the creation of friend groups for communication and collaborative content sharing and creation. But since Bluetooth v4.0 is only available in newer devices, its usability in a concert setting is severely limited.

Connectivity in live performance environments is a significant consideration even for Wi-Fi and Cellular technologies. Performance venues seldom provide Wi-Fi for audiences and the physical construction of venues frequently blocks out or impedes Cellular reception. Internet connectivity can become sluggish in high-density settings, such as crowded theaters. Major Wi-Fi suppliers such as Cisco and Aruba Networks have developed solutions for high-density settings, but these Wi-Fi grids are costly to design and install. Smaller venues can be equipped with Wi-Fi

connectivity for patrons at much lower costs, but the costs are not negligible. Consequently, an interactive system based on smartphones must not only take these limitations into considerations, it must actively seek to lower data usage and minimize the cost and difficulty associated with interactivity through internet connectivity. As will be seen in the following discussion of Nymbus, the means to achieve these objectives can be balanced through hardware, software, and user experience design.

4.2.1 Nymbus Website and Mobile Application

In the following sections, I will provide a general overview of Nymbus to orient the reader to its high-level design and feature set. In subsequent sections, I will begin to assess this design in greater detail, specifically applying the concepts of Passive-Dynamic Interaction design outlined earlier in this chapter.[338]

Nymbus is comprised of a number of differing interface components, all of which must be integrated with one another and the design objectives of the system as a whole. The first component of the platform is the mobile application (app) that audiences download from the Apple App Store (for iOS devices) or the Google Play Store (for Android devices). The second component of Nymbus is a Live-Cueing Console (nLCC) that enables musicians or other performance staff, such as lighting designers, to cue effects and interactions on audience phones through the mobile app. The nLCC can be downloaded and run directly from a local computer at the venue, but it can also be run as a web application through the Nymbus website.

[338] A general note, while some of the features discussed in this and the following sections have been built and received some testing, many of the features are still under construction. For stylistic concerns and out of great optimism that most of the features discussed will go live in the near future, I will discuss each feature in the present tense.

When concert designers and administrators visit the website, they are first greeted with marketing content that orients them to the features and process involved in using Nymbus. Periodically throughout this material they are presented with the option to create an account and begin designing interactive content. When a user decides to create an account, he is prompted to provide minimal identifying information and self-identify as an artist or venue representative (fig. 4.1).[339]

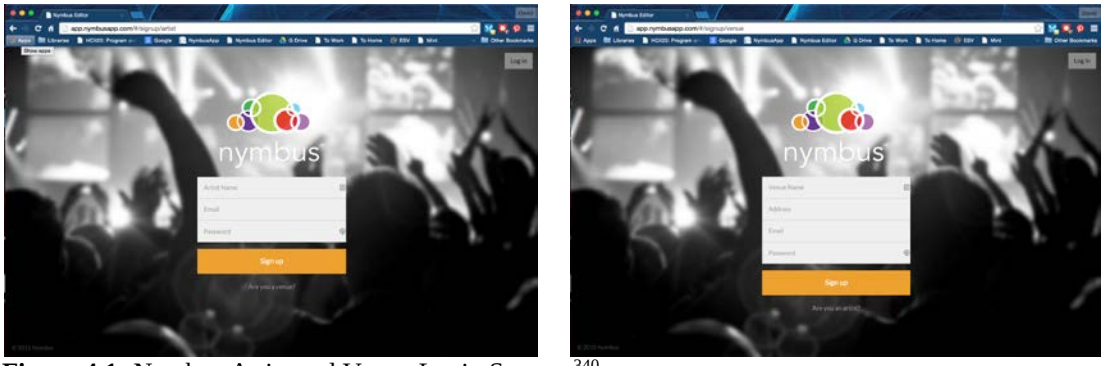

Figure 4.1: Nymbus Artist and Venue Login Screens[340]

Once logged in, the artist or venue can begin to create an event or series of events as well as edit profile information (fig. 4.2). This data will be directly used to populate the event details section of the mobile app to be discussed shortly.

[339] We are also creating Administrator accounts and will create a feature privileges layer for Artists to assign features such as the creation of light shows to lighting designers. Feature access is already distributed between Artists and Venues.

[340] Amoscato and Wright, "Nymbus Login."

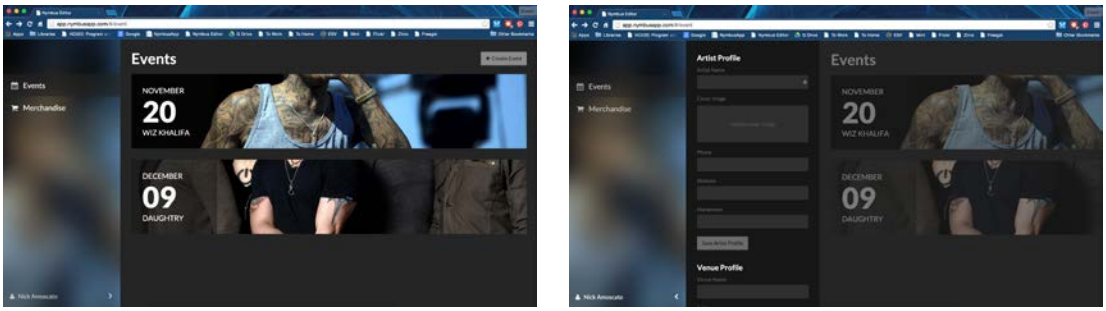

Figure 4.2: Nymbus Event List (left) and Profile Access (right).[341]

Clicking on the "+ Create Event" button at the top of the Event List page (fig. 4.2) opens a modal dialogue box in which the user can link the event to a venue, list the artist(s) playing in their order of importance, designate start times for each artist (known as the "slot list"), upload an event marketing image, and select from a pre-defined list of two-tone color pallet options that will be used to stylize the mobile app for that particular event.

Once an event is created, artists can open it and design their song set list for that event (venue operators are not allowed to define a set list for an artist). Each song title and by line is provided in the set list, which will also be used in the nLCC during the performance to cue the mobile apps to display the currently playing song title and by line (see fig. 4.3). Once a song is created in the set list, additional interactive features can be "attached" to it to be played back during the live performance. Clicking on a song in the set list opens up the Effects Design Console (nEDC) (see fig. 4.4). The nEDC will receive closer examination along with the nLCC below, but it is helpful to point out that the nEDC allows the designer to program a series of effects and interactions that use different components of the phone. The differing effect classes are: Color, Text & Image Overlay, Audio Playback, and LED Flash. Color lights up the phone screen and flashes and fades it between a wide variety of colors. Overlay displays text or images on the phone

[341] Amoscato and Wright, "Nymbus Create Event."

screen. Audio Playback plays recorded audio through the phone speakers. LED Flash will turn on or flash the phone's camera LED flash at any set beats-per-minute.

Figure 4.3: Nymbus Artist Set List.

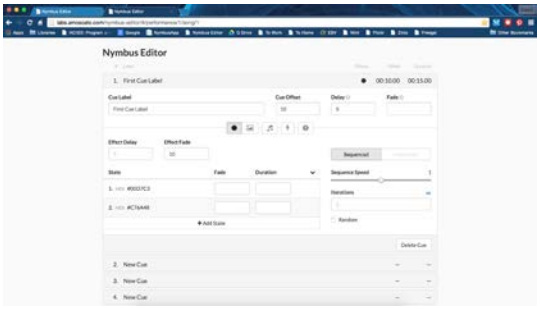

Figure 4.4: Nymbus Effects Design Console.[342]

Once a concert is set up on the website and programmed in the nEDC, it can be released to the mobile app. This release means that the event will appear in the app, audiences can open the app and see a list of events near them, but effects, song titles and by lines will not be visible until cued during the concert. The flow of the mobile app proceeds more or less in order from fig. 4.5 to Fig. 4.12.[343]

[342] Amoscato, Wright, and Norville, "Nymbus Effects Design Console v.1.0.," 2015Amoscato, Wright, and Norville, "Nymbus Effects Design Console v.1.0."

[343] A "paper prototype" of the app can be viewed at Amoscato, Wright, and Scherr, "Nymbus Mobile App Prototype."

Figure 4.5: Splash.

Figure 4.6: Event List.

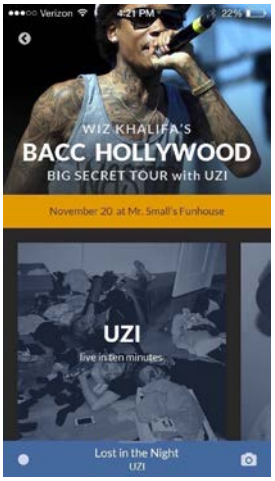

Figure 4.7: Event View.

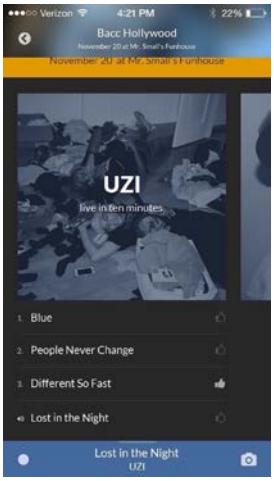

Figure 4.8: Slot/Set Lists.

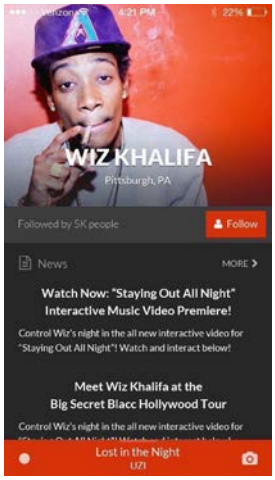

Figure 4.9: Artist View.

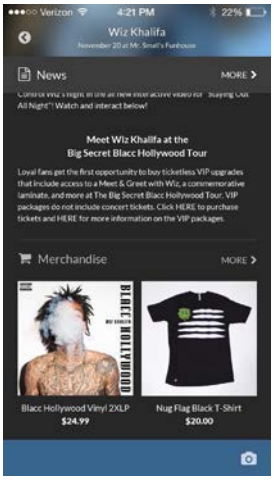

Figure 4.10: Artist Info.

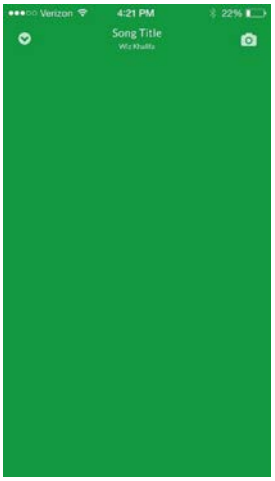

Figure 4.11: Light Show.

Figure 4.12: Concert Feed.

The welcome "splash" screen (fig. 4.5) greets the user and then is replaced by the list of events near the user (fig. 4.6). The first version of the app will merely display all the available events, but later versions of the app will show only upcoming events within geographical proximity to the user. When the user taps on an event in the list, she is taken to the event page (fig. 4.7) where she can see the slot list represented as a set of concert album covers ("UZI live in ten minutes" in figure 4.7). The user can swipe each album cover to the left or right to reveal the rest of the artists playing in the event and their start times. Hence, the album covers represent the event slot list. The user can also swipe up on an album cover to reveal the set list for that particular artist (fig. 4.8).

That set list will only populate as the artist plays a song and it is cued in real-time for display in the mobile app. Mobile app users can then “thumbs up” any of the songs in the set list. This “thumbs up” data will be collected for the artist to understand the response to their set list.

At the bottom of figures 4.6 to 4.10 the reader will notice a colored banner at the bottom of the screen. This banner features a Song Title and By Line in the center, a notification “dot” on the far left, and a camera icon on the right side of the banner. The Song Title and by Line is of the currently playing song. The camera icon allows the user to open their phone's camera within the Nymbus app. Since audiences will frequently take pictures during a concert, placing the camera icon in the app both allows and encourages the user to keep the app open during the concert. The notification dot shows the user if they have received a message from either the artist or a friend at the event. Artist notifications will be discussed in the next section, but notifications from friends can be either text notifications or they can be shared photos. Integrating photos and seamless photo sharing through the app is meant to minimize the amount of pictures taken at the event. If a user receives a notification that they have received a photo from one of their friends at the event, we hypothesize that they will be less likely to take their own photo of that moment in the concert. Tapping anywhere on the bottom banner excepting the camera icon will bring up the event “Timeline” (fig. 4.12). This timeline will include text and image messages from the artist, or to or from the user's friends who are using the Nymbus mobile app either before, during, or after the concert.

If the user taps on one of the album covers in the Slot List, they will be taken to that artist's profile page (fig. 4.9 and 4.10). In the profile page, they will find information about the artist such as a bio and Twitter feed. They can also purchase artist merchandise through the app. This artist information and merchandise display is set up on the artist's account on the Nymbus website.

4.2.2 Nymbus System Architecture Overview

Because of the impact of system architecture on efficient cause, form, and material in the design of Nymbus, I will provide a basic overview of it here. As mentioned earlier, cues are triggered on the phones using internet connectivity. This connectivity can be provided either through a Wi-Fi network installed in the venue or through cellular connectivity. Strictly speaking, internet connectivity is not needed; mobile clients (smartphones) could connect to a local Nymbus server via a local area network (LAN) that is not connected to the internet. However, practically speaking, an internet connection is needed because concert goers usually expect internet access through their mobile devices. If they are connected to a Nymbus LAN that does not have internet connectivity, they will have to disconnect from that LAN to connect to the internet via cellular service (or some other available Wi-Fi network). So, while Nymbus can be operated with a local server and LAN, internet connectivity is preferred. Figure 4.13 shows the platform operating over the internet.

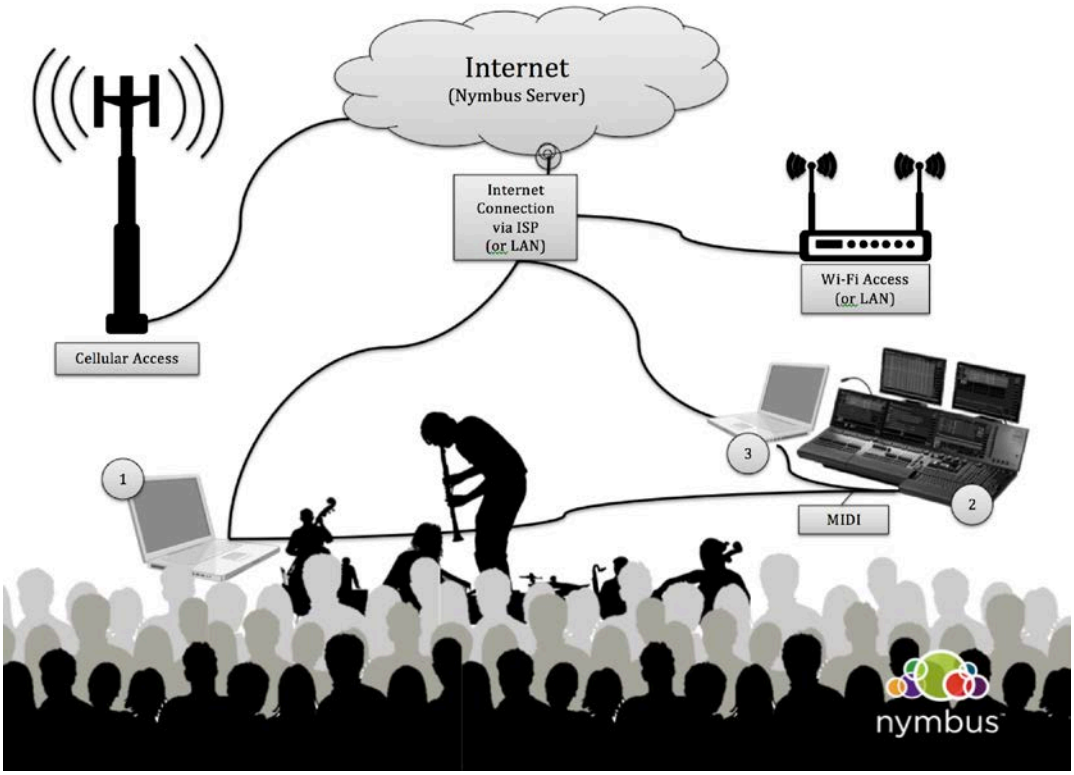

Figure 4.13: Diagram of Nymbus In-concert Network Architecture.

In fig. 4.13, (1) represents an on-stage computer used for live-cueing of effects and other interactions. The cuing may occur either through the nLCC, or musicians may plug MIDI compatible instruments into the on-stage computer and assign cues to instrument MIDI output. These cues are then either sent directly to the Nymbus server in the cloud, or sent via MIDI to a light board (2), which can also control cueing. Cues programmed on the light board are sent to a local computer (3) connected to the Nymbus server in the cloud. The Nymbus server receives cues and sends them to the mobile clients in the audience via a Wi-Fi network in the venue, or through cellular networks, or through a combination of Wi-Fi and cellular networks (depending on how the phones are connected to the internet).

This architecture provides artists and production designers with the greatest degree of flexibility in terms of cue execution. Not only can artists cue audience effects and interactions from the stage, they can do so using their own instruments using a MIDI connection. The integration

with MIDI also allows for a greater degree of specific interactions based on musical output. For, example, an on-stage keyboard could be used to turn audience phones a certain color depending on what chord the keyboardist plays. Alternately, a chord could be setup on the keyboard and then pushed to playback through audience phones. Alternately, audience members could be given directed control of an on-stage keyboard. For example, they could vote on chord progression from a limited subset of available chords and dynamics could in part be determined by audience movement.[344] On-stage musicians could then improvise off of this chord progression.

Through the use of MIDI, effects and interactions can also be put into sync with other visual effects programmed on the lighting board. Additionally, interactive feedback from the audience can be monitored and incorporated into the performance by a lighting board operator or other technical staff. While the examples of audience interaction in the previous paragraph focused on musical co-creation with the performers, bands might also want to allow the audience to post messages or display images on projection screens in the venue. Band members could not monitor this content during a performance, but a technical crew member would be able to monitor this content creation and posting.

The Nymbus platform's use of internet connectivity to deliver and receive data to and from the mobile clients in the audience enables two-way, data-rich interactions such as text messaging, images and sound, but the use of internet connectivity also presents a number of limitations and challenges. First, internet latency will invariably delay the communication between the server and the mobile clients, resulting in cues being out of synchronization with the music or out of sync across mobile devices in the audience or both. Latency can be minimized through existing

[344] A variation of this idea was first proposed to me in a conversation with Marty Ashby of Pittsburgh's MCG Jazz. Ashby, Personal Interview on a Possible Test of the Nymbus Platform with MCG Jazz.

technologies that maintain open connections between the server and client phones, but there will nonetheless be unavoidable delays in the communication between phones and servers.

In the first iteration of the Nymbus platform, we used a connection library called SignalR to establish real-time connections between the phones and the server.[345] We discovered through testing that SignalR came very close to instantaneous cueing of effects and synchronizing them across numerous clients. However, over multiple tests in differing environments, we discovered that cueing effects varied in timing and synchronization across clients. In some cases latency was hardly noticeable and synchronization nearly perfect, but in the majority of tests we noticed distracting latency of two to three seconds and asynchronous cueing across clients. Consequently, in the second iteration of the platform currently being coded, we are introducing logic into the connection that will account for variable network latency.

Strictly speaking, there is no way to eliminate network latency, but there are ways to work around it. The logic we are introducing into the server-client connection in the second iteration of the Nymbus platform is one such work around. When phones connect to the server there is a "handshake" process in which the client is identified by the server and content, such as the list of nearby events, is passed down to the client. In this handshake process, we will introduce logic in which the server and client transmit and receive the current time to each other multiple times in rapid succession. Over multiple transmissions, the client will be able to calculate the average network latency of its connection to the server and adjust the execution of cues accordingly.

With all clients knowing their latency relative to the server, we can achieve synchronicity if the server cues the clients and gives them a future time at which to execute that cue, say in 3 seconds. If one client has an average latency of 30 milliseconds and a second client has a latency

[345] SignalR, "ASP.NET SignalR."

of 15 milliseconds, then the first client will execute the cue in 3 seconds minus 30 milliseconds (2.07 seconds), and the second phone would execute the cue in 3 seconds minus 15 milliseconds (2.085 seconds). This means that while our logic synchronizes the clients, there is still latency between when a cue is given the “GO” by a musician or a run crew member. In order to sync the phones with the music, cues must be called *before* the music is actually played. This does not present too much of a difficulty because bands usually count in one or two measures to a song's down beat. This built-in buffer is all that is needed to put Nymbus cues right in sync with the music, much as musicians use this count-in to synchronize the ensemble.

Poor or no Wi-Fi or cellular signal strength in venues is a second challenge introduced by an architecture that requires internet connectivity. Other technologies, such as Glow Motion's LED wristband, overcome this challenge by using a specially licensed radio frequency that is transmitted by a device in the venue and received by the wristband. A couple of smartphone effects companies leverage the phone's internal microphone to receive a specially designed ultrasonic sound cue that is played through speakers at the venue.[346] While these methods are compelling, they do confront several difficulties. The limitations of Glow Motion have been discussed above. The use of ultrasonic cueing is interesting. Ultrasonic cues, by definition, cannot be heard by the human ear, but phones will also sometimes fail to “hear” the sound. Furthermore, ultrasonic cues are a one-way broadcast approach to interactivity, and have only been used to trigger pre-programmed cue stacks that are downloaded to phones or to cue phones to retrieve content from a server. A broadcast model of interaction does not create a reciprocal feed-back loop of interaction between the audience and performers, and if that feedback loop is created using internet connectivity, then adding ultrasonic cueing to the system is not necessary.

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[346] Wham City Lights, “Wham City Lights Homepage”; Signal360, “Signal360 Homepage.”

In the next section, I will discuss how the Nymbus Event Design Console (nEDC) and Live Cueing Console (nLCC) are specifically designed to create experiences that are robustly interactive.

4.2.3 Nymbus Event Design Console (nEDC)

Current smartphones are capable of an astounding variety of interactions. The nEDC is a crucial point in the creation of interactions between a musician and the audience. Its design must reflect the scope and limits of interactivity that both smartphones and the Nymbus platform are capable of delivering while simultaneously balancing flexibility in show design with constraints that ensure a high-quality user experience.

Determining what an audience should do with a mobile phone in a live performance will be discussed in more detail in the next section on passive-dynamic interaction design. But here it will be helpful to provide some high-level considerations in the design of an interactive platform for live jazz. Interactions that occur among jazz musicians on the stand are overt and communal. Overtness does not entail lack of subtlety; interactions among jazz musicians can be as subtle as a head nod, a look, a wink or playing slightly behind the beat. These actions are usually open to the perception of the entire ensemble and an attentive audience. The same overtness of interaction applies between audience members and between the audience and musicians. The shared community created in a jazz performance occurs through overt interactions.

Smartphones, on the contrary, introduce the potential for private interactivity with people not in the venue. Much of the outcry against smartphones in performance venues revolves around the fact that audiences usually use phones to engage with people and content that is outside of and often unrelated to the shared communal context of the live performance. Importantly, even if an

audience member is actually using the phone to tweet or text a friend or acquaintance in the venue about the performance, audience members surrounding them will not know that they are engaged in conversation about the show. Indeed, given the sheer vastness of communications that occur on personal devices, audience neighbors are justified in the assumption that someone engaged in a text conversation through a smart device is *not* participating in the show.

Some productions have attempted to engage smartphone-using audience members by providing online content meant to be accessed in tandem with the live experience.[347] Similarly, lively virtual conversations have been created using Twitter hashtags during live concerts. Tracy Cowden, professor of piano and voice at Cincinnati's School of Performing Arts, reported that students in her Tweet Seat Master Class engaged in multiple, simultaneous conversations about and during a performance via Twitter hashtags. She observed that "In a theater, they're not allowed to move—but on Twitter you can shout out."[348] However, even in these structured engagements, the need remains to "protect" traditional audience members from the distraction of differing forms of engagement. The "shouting" in these Twitter conversations occurred within black boxes placed on student's laps, concealing phone and screen light from other audience members. While hiding online engagement during a performance protects traditional audience members from potential distractions, an alternate approach would make those interactions as overt and communal as possible, thereby minimizing distraction by emphasizing participation. This has been the strategy of the Nymbus system.

To that end, the first iteration of Nymbus has attempted to focus on the smartphone as a lighting instrument. I reasoned that adding an audience-based visual lighting component to a

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[347] See for example, Netburn, "Theaters Set aside Tweet Seats for Twitter Users;" Gardner, "Switch on Your Phones."

[348] Millholland, "Tweeting for Class."

performance could potentially create the most overt interactions, while minimizing the alteration of performance choices by performers themselves. In addition to lighting up the phone screen and LED flash, we also built in the ability to send basic text messages for display on the phone screen, play an mp3 file through phone speakers and end the show with an “End Show” screen that includes a dynamically changeable link out of the app to some form of web-based content, such as an online survey, image, or website. These effects each have variable parameters (e.g. Start and end colors of cross-fade, LED flash beats-per-minute, etc.) that are programmed into a comma separated values (.csv) document, which is then uploaded to a website. So, for example, if a designer wanted to flash all of the LEDs on audience phones at 60 beats-per-minute (bpm), this would be written in a .csv file as a single line of instructions and uploaded to the cueing website. Then, at the appropriate moment in the performance, the designer would simply click on this file on the website, the cue would be sent to the phones, and the LEDs in the audience would begin to blink.

This is a simple cue example, but multiple lines of cues can be added to a single .csv file. For example, the designer could add a fade from blue to green on the phone screens either after the LED blinks for a defined time, or she could execute that fade while the LED continues to blink. She could also display a text message during this fade. Figure 4.14 is a list of all the available effect types that can be cued on a phone using the Nymbus prototype.

	A	B	C	D	E	F	G	H	I
1	Color	id=1	offset=1000	color=255:0:0|0:0:255|0:255:0	baseIntensity=10	duration=1000			
2	ColorFlash	id=2	offset=2000	color=255:0:0|0:0:255	baseIntensity=10	flashBpm=60	playInSequence=1	duration=1000	
3	CrossFade	id=3	offset=3000	beginColor=0:255:0	duration=1000	finalColor=0:0:255			
4	Gradient	id=4	offset=6000	topColor=0:255:0	bottomColor=255:0:0	duration=1000			
5	IntensityShake	id=5	offSet=5000	color=0:0:255	baseIntensity=10	baseMovement=20	maxIntensity=100	maxMovement=20	duration=1000
6	Led	id=6	offSet=6000	intensity=100	duration=1000				
7	Strobe	id=7	offSet=7000	flashBpm=60	intensity=4	duration=1000			
8	TickerTape	id=8	offSet=8000	text=The Text	verticalAlignment=c	horizontalAlignment=c	duration=1000		
9	ColorShake	id=9	offSet=9000	beginColor=255:0:0	finalColor=0:0:255	duration=1000			
10	EndShow	id=10	offset=10000	content=This is the content.	duration=1000				
11	Mp3Playback	id=13	offset=13000	files="file|file|file"	playInSequence=1	duration=1000			

Figure 4.14: List of Nymbus Effects in the Prototype Version.

The reader will notice that each effect type, in addition to having a name (Color, ColorFlash, CrossFade, etc.) and an ID number (id=1, etc.), each effect type includes an offset

(measured in milliseconds). After a phone receives a cue stack from the server, it will immediately play each effect cue in sequence based on its millisecond offset time.[349] Thus, a complete cue stack for a single song can be quite simple, perhaps consisting of a simple color fade on the screen and a text display of the currently playing song title and by line. Alternately, a cue stack can be quite complex. Figure 4.15 demonstrates the complexity that can be programmed into a single cue stack that lasts a mere sixty seconds.

	A	B	C	D	E	F	G
1	Color	id=1	offSet=0001	color=70:99:176	baseIntensity=100	duration=0999	
2	Color	id=1	offSet=1000	color=254:219:97	baseIntensity=100	duration=1000	
3	Color	id=1	offSet=2000	color=180:0:24	baseIntensity=100	duration=1000	
4	Color	id=1	offSet=3000	color=70:99:176	baseIntensity=100	duration=1000	
5	Color	id=1	offSet=4000	color=254:219:97	baseIntensity=100	duration=1000	
6	Color	id=1	offSet=5000	color=180:0:24	baseIntensity=100	duration=1000	
7	CrossFade	id=3	offSet=6000	beginColor=70:99:176	fadeDuration=4000	finalColor=255:255:255	
8	CrossFade	id=3	offSet=10000	beginColor=255:255:255	fadeDuration=3000	finalColor=70:99:176	
9	CrossFade	id=3	offSet=13000	beginColor=70:99:176	fadeDuration=3000	finalColor=255:255:255	
10	Color	id=1	offSet=16000	color=255:255:255	baseIntensity=100	duration=0500	
11	ColorFlash	id=2	offSet=16500	color=254:219:97	baseIntensity=100	flashBpm=360	duration=5500
12	Strobe	id=7	offSet=17000	flashBpm=360	duration=5000		
13	Color	id=1	offSet=22000	color=255:255:255	baseIntensity=100	duration=5000	
14	Led	id=6	offSet=22000	intensity=100	duration=5000		
15	ColorFlash	id=2	offSet=27000	color=70:99:176	baseIntensity=100	flashBpm=120	duration=3000
16	ColorFlash	id=2	offSet=30000	color=254:219:97	baseIntensity=100	flashBpm=120	duration=3000
17	ColorFlash	id=2	offSet=33000	color=70:99:176	baseIntensity=100	flashBpm=120	duration=3000
18	ColorFlash	id=2	offSet=36000	color=254:219:97	baseIntensity=100	flashBpm=120	duration=4000
19	ColorFlash	id=2	offSet=33000	color=70:99:176	baseIntensity=100	flashBpm=120	duration=3000
20	Color	id=1	offSet=40000	color=180:0:24	baseIntensity=100	duration=4000	
21	Color	id=1	offSet=44000	color=254:219:97	baseIntensity=100	duration=4000	
22	Color	id=1	offSet=48000	color=180:0:24	baseIntensity=100	duration=1000	
23	Color	id=1	offSet=49000	color=254:219:97	baseIntensity=100	duration=1000	
24	Color	id=1	offSet=50000	color=180:0:24	baseIntensity=100	duration=1000	
25	Color	id=1	offSet=51000	color=254:219:97	baseIntensity=100	duration=1000	
26	ColorFlash	id=2	offSet=52000	color=180:0:24	baseIntensity=100	flashBpm=240	duration=2000
27	Strobe	id=7	offSet=54000	flashBpm=120	duration=4500		
28	CrossFade	id=3	offSet=58500	beginColor=180:0:24	fadeDuration=1500	finalColor=70:99:176	
29	CrossFade	id=3	offSet=60000	beginColor=70:99:176	fadeDuration=2000	finalColor=180:0:24	

Figure 4.15: Example Cue Stack for the Nymbus Prototype.

Because each cue requires an offset, one or more color values (in Red:Blue:Green format), lighting intensity values, and duration, programming these cue stacks is quite tedious. Cues can be programmed to overlap in timing, which enables quite a bit of flexibility and is sometimes useful, but often the result is not desirable. For example, overlapping two color cues will force the phone to display to colors simultaneously, which results in interesting but often unexpected color mixes.

[349] In the prototype, a cue stack is defined by as all the cues in a .csv file uploaded to the server. In the second iteration of Nymbus, cue stacks are much more variable and programmed directly through the nEDC.

Much of the tedium of programming cue stacks for the prototype could be eliminated with a user interface that is more sophisticated than a .csv file.[350] For example, a simple color picker could replace the RGB values needed to program a basic Color or CrossFade effect.

Many of these improvements are being incorporated into the second version of the platform. We are also drastically reconceptualizing the timing and hierarchy of effect cues in the second version. This reconceptualization arose through in-depth conversations with lighting designers and light board programmers and utilizes much of the conceptual framework of existing theatre light systems. For example, current lighting systems do not set effect durations. Once a lighting instrument or other effect device is placed into a state, it remains in that state until it receives instructions to change states. A moving light, for example, might receive instructions to assume a particular focus position, color and beam size, and it will stay in this state until it receives a change to this configuration. This directly conflicts with the Nymbus assignment of durations to effects after which the phone returns to a black screen or the initial welcome splash screen.

Similarly, current lightning logic conceives of fades between colors not as a move from a start state to an end state defined within a single cue, but rather the time it takes for a lighting instrument to achieve a full transition into the new cue from its prior state. Fade cues in the Nymbus prototype always require a starting state and an end state. For example, as can be seen in fig. 4.14, CrossFade (line 3) defines a “beginColor” RGB value (state 1), a “finalColor” RGB value (state 2), and the time it takes to move from state 1 to state 2, called “fadeDuration” and expressed in milliseconds.

[350] In fact, for some of our tests that required multiple cue stacks that merely displayed a song title and by line on a black background, one of the developers created a simple program that would generate .csv files set to run for three minutes. A designer had to merely enter a song title and by line, and the program would generate the .csv file.

This reconceptualization of device effect sates as holding no duration greatly simplifies cue stacks and introduces a additional level within the design hierarchy. The Nymbus prototype has two basic levels of conceptualization with which a designer interacts: cue and cue stack. While a single song can have either a single cue stack (the most frequent scenario to date), a song could also utilize a number of cue stacks that are sequentially triggered by a crew member at the concert. Nymbus v.1.0 introduces the notion of two or more “Effect States” and the transition between states within a single cue. Cues themselves do not have durations; they perdure until a new cue is called either manually on the nLCC or by the cue's offset time. Effect States on the contrary may be given a duration, but this duration does not operate in the same way that it does in the prototype. The duration of a state defines the rate of change between states within a single cue. Thus, if a designer wants to define a transition from red to blue on the phone screens, she would create a cue with two states in it, red and blue. Then she would define the duration of each state, say ten seconds each. The mobile client would receive this cue, begin in a state of red for ten seconds, transition to blue for ten seconds, and since there is no further state defined, it would remain in the blue state until it received a command to change its state again.

Effect States may also be assigned a fade value, the time it takes the client to transition from its current state into the new state. Furthermore, a list of effect states within a single cue may be looped or randomized. In the red-to-blue example, looping between states merely means that the client would transition from red to blue and from blue to red indefinitely or for a predefined number of loops, holding each color for ten seconds each. This would continue until it receives an updated command to assume another state. Randomization means that the client would pick at random between the states defined in a cue and execute each state according to its defined fade

time and duration. This could achieve a randomized pattern of light across multiple devices in the audience. Figure 4.16-4.17 show the first iteration of the Nymbus v.1.0 nEDC.

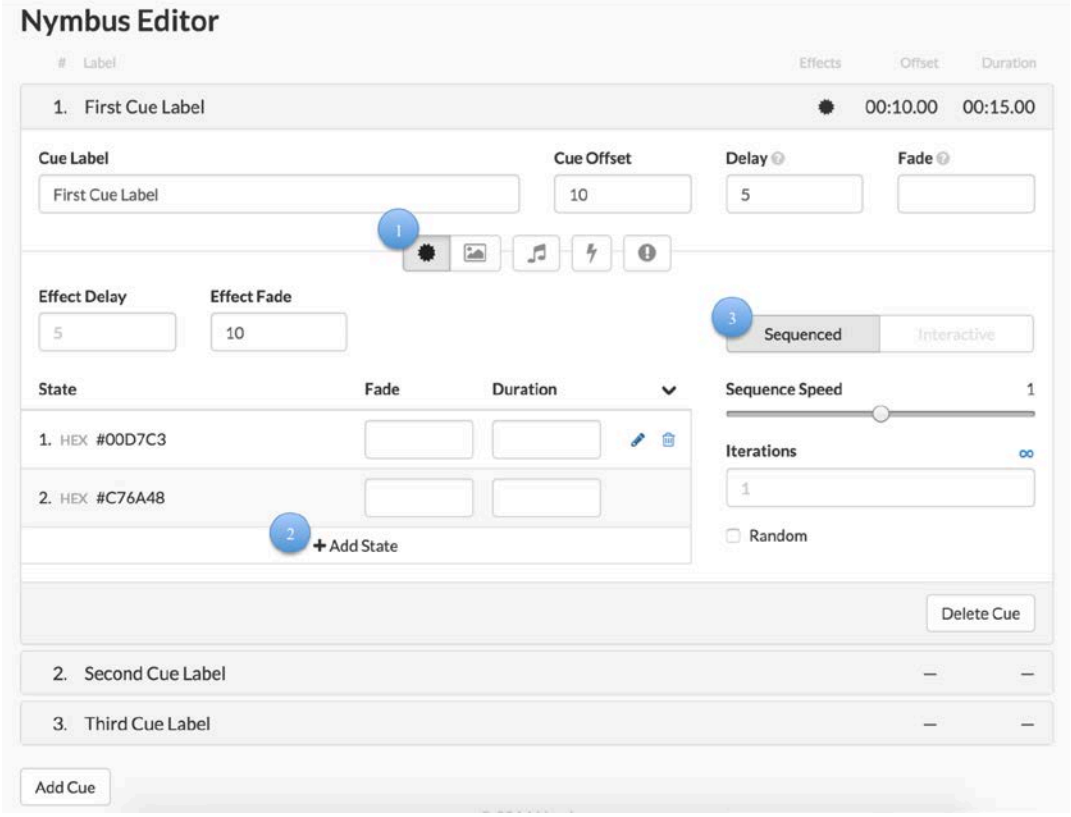

Figure 4.16: Nymbus v.1.0 nEDC First Iteration.

The nEDC is designed to allow designers to create a set of cues, within which are a set of states for various effect types. To create a cue, a designer clicks the "Add Cue" button at the bottom of the cue stack. The new cue opens, revealing Label, Offset, Delay and Fade fields and the list of effect types that can be added to the cue. In fig. 4.16, (1) marks effect types. From left to right these effects are: screen color, image overlay, sound playback, LED Flash, and phone vibrate. Once an effect type has been selected, the user adds states to it by clicking "+Add State," (2) in fig. 4.16. In figure 4.16, the screen color effect is selected, and effect states can be assigned a color in either

RGB or hexadecimal values.[351] Fade times and duration can also be specified. (3) in the figure marks a toggle function that determines if effect states are sequenced or interactive. The timing of sequenced effects is first determined by the duration of each effect, but by adjusting the "Sequencing Speed" slider, the user can increase or decrease those durations by a multiple represented by the position of the slider. Sequencing may also be infinite or set to a specific number of iterations. Sequenced effects can also occur in a randomized order as opposed to the created order of the states.

Sequenced and randomized effect states are the norm for traditional lighting instruments, but Nymbus seeks to create interactive participation by giving the audience the ability to manipulate effects on their phone through simple gestures. Allowing the audience to change effects by, for example, shaking their phone is rather an open-ended description of interactivity. What effects are to be changed by a phone shake? What degree of movement is required? What happens when the user stops shaking the phone? Are gestures other than shaking the phone allowed? After extended discussion, prototyping and testing, the Nymbus team and I selected a handful of parameters that can be applied to basic effects to make them interactive. Figure 4.17 below shows the controls that we deemed necessary for interactivity.

[351] Hex values are displayed in fig. 4.16, but if the user clicks the pencil icon to the right of the duration field, a modal opens up with a graphical color picker and fields to manually adjust both RGB and hexadecimal values.

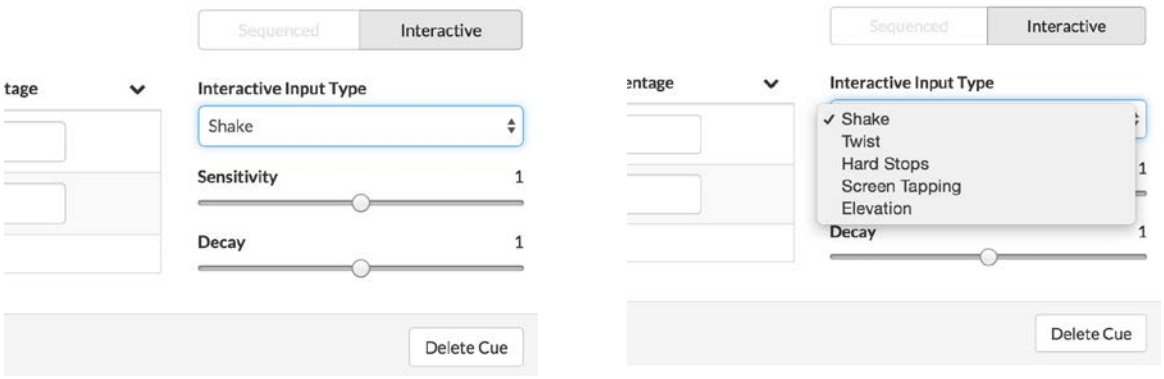

Figure 4.17: nEDC Showing Effect States Toggled to be Interactive, Sensitivity and Decay Adjustment Slides (Left), and the Variety of User Input Types That can be Assigned to a List of Effect States (Right).

The reader may have noticed that fig. 14.4 above, shows two interactive effects programmed in the prototype: “IntensityShake” (ln. 5) and “ColorShake” (ln. 9). IntensityShake increases the intensity of screen brightness in response to phone movement. ColorShake changes screen color in response to movement. We experimented with these two screen color effects and found them to be quite engaging, but were not ultimately able to include them in the version of the app that was released into the app stores.

However, from these experiments with interactive effects, we learned that designers needed to be able to control the phone's sensitivity to user input. Hence, the sensitivity slider in the new version of the nEDC. Additionally, we discovered that feedback on user engagement needs to be complimented with reverse feedback as users ceased interaction with the effect. Hence, the concept of “Decay” was introduced, which means that the phone will return to its prior state by degrees if the user stops the particular interactive input type assigned to the effect.

In addition to shaking the phone, we allowed designers to choose from four other interaction input types (see the right image in fig. 4.17). “Twist” sequences through effect states as the phone is twisted back and forth around a vertical or horizontal axis. “Hard Stops” cycles effect states as the phone registers rhythmic, pendulum motions punctuated by pauses at each side of the pendulum period. For example, swinging the phone to the right could turn the screen blue;

swinging it to the left could turn it green. “Screen Tapping” allows the user to cycle through effect states by tapping the screen. For example, tapping the screen might cycle through a variety of colors on the screen or activate the LED flash (theoretically in time with the music, but the period would be determined by the user). “Elevation” can be used to manipulate effects by raising or lowering the phone. When applied to image overlay effect states, raising and lowering the phone could be used to zoom in on images. When applied to sound effects, raising and lowering the phone could modulate chords or cycle up or down the notes in a scale.

As indicated in the prior paragraph, effect interactivity can be assigned to any of the effect types with varying results. An image could be made to “bounce” around the screen or simple animations could be created with a series of images in sequence. LED flashes could be correlated to phone movement and sound can be manipulated by audience behavior. In the interest of flexibility, we have purposefully left these parameters fairly open-ended. Designers might create a sequence of interactive effects across a number of the differing effect types. These interactions might conflict; determining the best design will require experimentation and testing in rehearsals.

We also plan to introduce the concept of an “Interaction Threshold” into the next iteration of the nEDC (see fig. 4.18). A threshold is a point at which audience interaction with a sequence of effect states becomes constant and/or reaches a specified level of intensity and the mobile client proceeds beyond the threshold into a second sequence of effect states that may be either sequenced, randomized or interactive. For example, a designer might want the audience to begin moving in time with the music as a precursor to the introduction of a syncopated section in by the musicians. The designer might program a sequence of LED flashes to be sequenced as an audience member taps on the screen. Then the designer can create a threshold that defines when the phone screen will begin flashing in syncopation to the LED flash. Once the audience member taps a certain

number of times at a specified beats per minute, the phone screen might begin flashing blue in syncopation to those LED flashes.

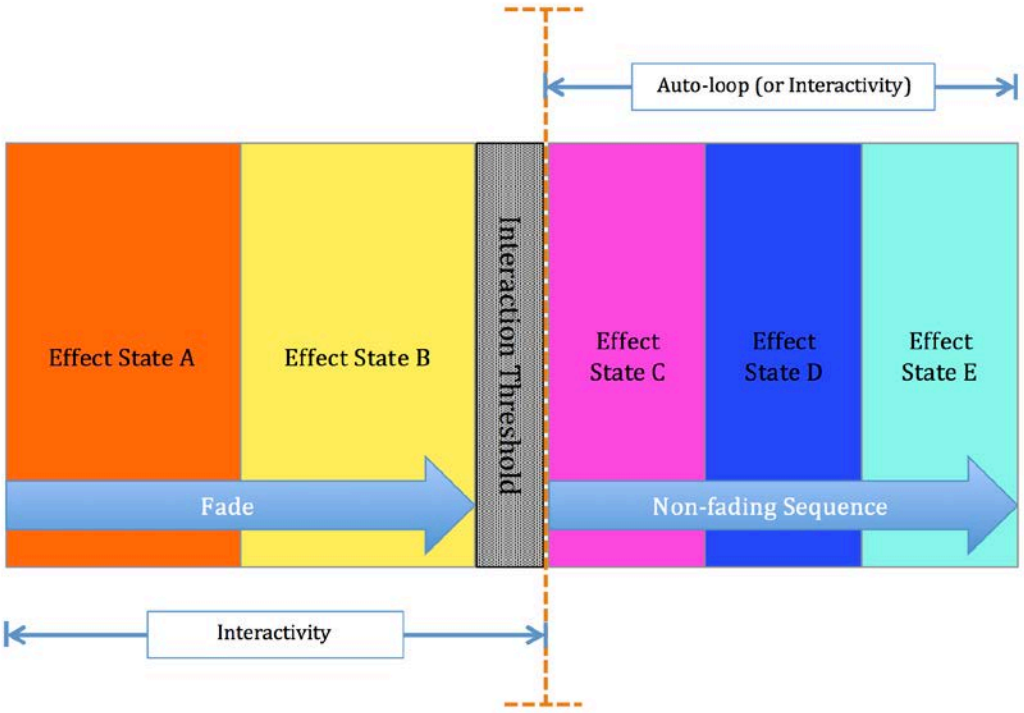

Figure 4.18: Diagram of Interaction Threshold between Sequenced States. In this scenario, effect state A fades through to state B as defined interaction is provided by the user. Once that interaction has reached the threshold level, the mobile client then auto-loops between effect states C, D and E. Alternately, interactivity may be applied to the non-fading sequence of effect states C-E. The orange, dashed line indicates the moment when a threshold has been crossed.

As indicated by the thickness of the "Interaction Threshold" bar in fig. 4.18, a threshold requires interactors to perdure in threshold interaction for a set amount of time, repetitions or intensity in order to cross the threshold and move into the second grouping of effect states defined within the cue.

The Nymbus team and I considered allowing designers to create multiple thresholds within a single cue, but this idea was ultimately rejected because it might create ambiguous feedback to the interacting audience. If one audience member passes beyond a second threshold, while another

audience member remains in the sequence of effects beyond the first threshold, while a third audience member has not yet crossed the first threshold, it would be difficult to keep track of where everyone was in the sequence of effects separated by thresholds. These three audience members might begin to think that the effects are randomized. We want to create a clear sense of progression within the cue stack and cohesiveness among the audience.

In the next section I will consider the design of the Nymbus v.1.0 Live Cueing Console (nLCC). This console is of paramount importance because it provides an important component of the Nymbus interface between the audience and musicians. This is merely a "component" of the Nymbus interface between audience and musicians, it does not comprise the entirety of the interface. Conceiving of platform design as a whole, the interface design consists of both analogue and digital interactions with an attempt to create a fluid blending of the two.[352]

4.2.4 Nymbus Live Cueing Console (nLCC)

The Nymbus prototype approaches the live cueing of concerts in a linear manner. What I have referred to as "cues" in discussing the prototype are actually a series of device effect states assigned certain properties including duration and an offset. Thus, the effect state is the basic, autonomic element of the system, and a state must be allowed to end before it can be replaced with a different state. This means that if a musician or crew member wants to jump between cues in a performance, the jump will not take place until the current effect state has ended. For example, it is possible to move from cue 1 to cue 5 and then back to cue 2 in real-time on the prototype, but these moves

[352] By "analogue" I mean interactions that do not require an abstraction of an action into the 1s and 0s of binary digital media. For example, a flashing screen might require a digital abstraction of an audience member's screen tapping, but the flashing light itself is an analogue communication between the audience member and the artist. The performing artist does not see the light mediated through a digital media.

between cues will only occur at the end of an effect state regardless of when a new cue is triggered by an operator. If the mobile clients are rendering an effect state in cue 1 that has a duration of three minutes, then if the musician triggers cue 5 half-way through that effect state, cue 5 will be rendered one and one-half minutes after it is triggered. In practice, most effects are programmed to be relatively short and switching between cues does not have a long delay. However, this data structure is not optimal. In addition to this delay problem, the entire stack of effects in a cue must be sent to the mobile clients anytime a new cue is triggered. While most prototype cues are relatively "light" (meaning that they use small amounts of data), more sophisticated cues that use images or play audio will be considerably heavier, leading to unnecessary network delays.

To facilitate greater flexibility in cueing and greatly reduce the amount of data sent to the mobile clients during a performance, the development team re-envisioned the data structure to make cues, rather than effects, the basic atomic entities of the data structure. Cues are abstract entities that include minimal data consisting of 1) parent cue reference (value may be NULL), 2) time offset within the cue stack, and 3) "effect channels" that tell the mobile client what effect should be rendered in that particular cue.

When a mobile client contacts the server for the first time at a performance, the server will send it all of the effect states (aka effect configurations) that will be use in the performance. When a cue is triggered during a live performance, rather than sending the entire stack of effect states, the cue data will merely provide a "map" of when performance effects are to be rendered relative to the time of the triggered cue. The mobile client receives this basic set of instructions and renders the effect states, which it has already received, in the order that they are specified by the cue. The resulting data structure is mapped accordingly:

- Event (Concert)

- Artist 1
  - Song 1 Cue
    - song status effect type
      - 0 – song name, meta, etc.
    - Cues
      - Cue 1
        - effect type 1
          - effect configuration at time 1
          - effect configuration at time 2
          - ...
        - effect type 2
        - …
      - Cue 2
      - …
  - Song 2 Cue
    - song status effect type
      - 0 – song name, meta, etc.
    - Cues
      - …
  - Song 3 Cue
    - ...
- Artist 2
  - Song 1

- …

In addition to greatly reducing the data sent to mobile clients over the wireless network, this new data structure easily facilitates switching between cues in real-time and triggering additional cues to run concurrently with a prior cue. Rather than maintaining a strict linear progression, cues can be efficiently nested within one another, creating “blocks” of cues that can be easily reused from one song to another or at different points within a single song.

Before moving on to the user interface of the nLCC, I would like to emphasize the conceptual importance of this re-designed data structure, which makes the cue its foundational, atomic element. Within existing live performance technologies and even in communication among performers unaided by technology, a cue is a moment of action that often elicits a response. In theatre, we speak of the stage manager's cue to “GO” a light, sound or scene change. Alternately, stage managers might direct their run crew to take the cue directly in response to a movement, word, or sound from the performers themselves. In jazz performance, a cue functions in much the same way among ensemble performers. Musicians will indicate their desire to improvise for an additional chorus with a slight gesture to the rest of the ensemble. Thus, by making the cue the basic element in the Nymbus data structure, action and interaction are the foundation of the Nymbus v.1.0 data structure. The prototype made mobile device states the foundational, atomic element of the data structure. This will become important to the discussion of material cause and passive-dynamic interaction design below.

Interactivity has always been the chief objective of Nymbus from a user interface perspective. As was indicated in the architectural overview, we plan to enable MIDI cueing so that musicians can use instruments to trigger cues in the audience. The first iteration of MIDI cueing will trigger cues created in the nEDC and revealed for live cuing in the nLCC. Before MIDI cueing

is enabled, the nLCC will be used by musicians on stage or by a run crew member. Figure 4.19 shows an initial iteration of our design of the nLCC.

Figure 4.19: Wireframe of the nLCC.

The nLCC is accessed through an artist's event page. Once songs have been assigned to an artist and added to an event (creating a set list), they appear in the nLCC under that event title in the left-hand navigation bar displayed in fig. 4.19. At a basic level, each song will include a title and by line to be sent to audience smartphones during a live concert. But a host of other interactions can be created and added to the song including questions or audience polls, direct text and photo messages to the audience, and coupons for the purchase of merchandise and/or food and beverage either through the mobile app or at a merchandise table or bar in the venue.

As cues of these various types are created and attached to a song, they may or may not include an offset time, which is the time they will play after the entire song cue stack has been

triggered. Thus, the song cue stack includes only the cues with offset times, and when a song cue (the highest level of cueing) is triggered, the mobile clients will receive the song title and by line and all of the cues that have been assigned an offset time. All cues in a song that include an offset time (aka chronological cues) are listed under the "All" tab in the center section of the web app. The other tabs to the right of the "All" tab are filters that arrange cues both with and without offset times according to type (effects, questions, messages, photos and coupons).

A playback bar is displayed at the bottom of the nLCC. If a song is selected in left-hand column and the play arrow is clicked in the playback bar, then each cue with an offset time will play in succession. The forward and back arrows advance or revert to the adjacent song in the set list and immediately begin playback from the first cue in the cue stack. The pause button halts the progression of cues, meaning that the server will not trigger any more cues until the play button is clicked. During pause, the mobile clients will continue to play the last cue that they received. In order to halt all cues and return to the event main page in the mobile app, the operator must press a blackout button (discussed but not yet added to the design). The operator may also move between cues in the chronological cue stack (the "All" tab) by merely selecting them in the stack. A cue selected in the stack is played immediately and interrupts whatever cue is currently playing on the mobile app.[353]

When one of the cue filters is selected, all of the song cues of that type are displayed. While cues with and without offset times are displayed in a filtered view, offset times are of no consequence in this view and are greyed out. When the interactor clicks on one of the cues in the

[353] "Immediately" is a relatively term due to network latency discussed above. In our experience, cuing over SignalR is relatively immediate even when serving audiences of 400 to 600. However, when a client receives the cue it will begin playing it offset from the moment it was cued on the server. Also, if a cue within the chronological cue stack is selected for immediate play, a confirmation modal will open requiring the interactor to confirm the cue "GO." This is because chronological cues interrupt currently playing chronological cues.

filtered view, that cue is played immediately. If chronological cues are playing when a non-chronological cue in one of the filtered views is selected for playback, then the mobile clients will continue to play the chronological cue stack in the background, render the new cue, and then return to its current place in the chronological cue stack. Using the cue stack in fig. 4.19 as an example, if the mobile clients are rendering the cue stack and have reached cue 4 at 1:49 in the stack, they would ordinarily display "Bill Evans on Piano" on top of a blue-green lighting effect. However, if Bill is not playing that evening, the console interactor might select the "Messages" tab and play an updated message with the name of the new soloist for the evening. That new message would display until the next cue in the chronological sequence is played (a white visual effect at 2:27 in the fig. 4.19 example). Thus, the cuing interactor can "insert" new cues into a chronological cue stack without completely interrupting or halting that flow of cues, which creates a highly flexible live cueing experience.

The cue filters display only cues that have been created before the concert begins and attached to the event or a song in the event set list. This allows interactors to plan interactions that they believe will likely occur at some point in the concert narrative. However, they might also wish to create and execute cues in real-time in response to audience interaction. It would be difficult to build entirely new effect cues (sounds, lights, etc.) mid-performance, but text, pictures, audience polling, and coupons could easily be added. In the upper right-hand corner of the nLCC, four icons represent these cue types that can be created and cued "on the fly." These cues will function much like cues in the filtered lists—they replace the currently playing cue without halting playback of a chronological cue stack.

As cues are played, they appear in a vertical feed on the far right column of the nLCC, similar to a Facebook or Twitter feed. This feed will represent audience-wide visual and aural

effects in a song on a post for the song as a whole, but it will provide a separate post for text messages, images, polls, and coupons released to the audience. Responses to these posts from the audience will be displayed under the cue in this feed.

4.2.5 Passive-Dynamic Interaction Design Applied

When applying passive-dynamic interaction design to the Nymbus platform, it would be a mistake to think that by merely mapping one-to-one the formal, material, and efficient properties of jazz music onto the platform we would arrive a symbiotic relation of the new tech and the jazz experience. Passive-dynamic design in robotics requires a more nuanced understanding of the principal and the same is required in this application. For example, the robot “Puppy” could efficiently scramble up slippery surfaces in part because of the material construction of its feet created rapid feedback about its progress up the slope, which resulted in quick responses to slips. Smooth aluminum was *not* selected as the material component of Puppy's feet because it mapped one-to-one to the slippery surfaces upon which the robot would walk. The material was chosen because it yielded a robot-environment interface that created a rapid feedback loop from robot action, to effect in relation to the environment, to compensatory action.

Similarly, we should not expect that, for example, identifying sound as the material cause of a jazz performance and including sound in the design of Nymbus will yield passive-dynamic interactions. We must look at the function of sound within the context of the ensemble to better understand its implications for design.

The following three sections will look at each of the first three causes of jazz performance (material, formal, and efficient) respectively, and relate them to the causal design of the Nymbus platform. Segmenting the four causes into individual assessments is a bit artificial; the causes all

hold complex interrelations. Similarly, the Principal of Ecological Balance proposes "…a certain balance or task distribution between morphology, materials, control, and environment."[354] However, the segmentation of causes is necessary for the sake of clarity, and I will attempt to draw out the interrelations as much as possible.

4.2.5.1 Ecology Object Material (Material Cause)

Daniel Levitin identifies seven "major elements" of music: pitch, rhythm, melody, harmony, tempo, meter, and loudness.[355] Levitin argues that loudness and pitch are perceptual properties, "…entirely psychological phenomenon, [they] don't exist in the world…only in the mind."[356] Without delving into the philosophical implications of the mind-world duality implicit in Levitin's claim that psychological phenomenon do not exist in the world, it is safe to merely concede that loudness and pitch correspond to a relation between sound and the human ear and brain. The other elements of music can be defined by physical regularities in musical sound waves without reference to their reception in the brain. Rhythm, tempo, and meter correspond to the regularity and speed of sound and silence over time, creating patterns of accentuation in relation to a regular tactus. Melody arises as relations are set up between tones, thereby creating a pattern that often repeats within the course of a song and usually follows certain principals of Western music (or Eastern, but we are talking about jazz) that have become homological. Harmony, like melody pertains to regular relations between musical tones.

However, in describing rhythm, melody, harmony, tempo, and meter in terms of "regularities," "patterns," "repeating relations" and the like, it becomes apparent that we are

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[354] Pfeifer and Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence*, 123.
[355] Levitin, *This Is Your Brain on Music*, 69.
[356] Ibid., 67.

dealing with more than merely the material of music. Rather, these are elements of the form applied to the material, the formal cause. Sound frequencies themselves, or perhaps particular sound frequencies common in Western music, are the primary material cause of jazz music.

Yet, we cannot limit the material cause of jazz performance to sound waves alone; those sound waves are made by material instruments, in physical spaces, by musicians for an audience. Thus, we should add at least wood, brass, steel, felt, nylon, drum skin, reed, bronze, and human flesh and bone.[357] But there is also a close connection between material and formal causes in the materials of jazz instruments. It is the form that these materials take that plays a large role in making up their distinctive timbre of the sound. Furthermore, efficient cause is also implicated in the timbre of jazz instruments. Beyond the acoustic properties of an instrument's materials and shape, timbre is composed of a "sound envelope" that is particularly marked by the "attack phase" when a musician strikes, plucks, or blows into the instrument thereby instigating the sound that subsequently resonates throughout the instrument.[358] The importance of musical action on timbre illustrates the close link between efficient cause, material, and formal cause in music.

We can also extend the material cause into the audience. The acoustic properties of bodies in a performance space are often observed to impact the performance itself, how musicians hear and play their instruments and how the sound carries about the room. Light, while not strictly necessary for expert musicians in a well-rehearsed ensemble, also plays a key role as a material cause of the performance. Not only do musicians usually require some light to read lead sheets,

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[357] This list is not exhaustive nor is it particular. There are many other materials in a particular musical setting that can impact the performance. But I am after generalities at this point in the argument. In some cases, dinner and drinks make up a crucial part of the performance. In some cases expanses of dance floor figure prominently; in others, densely packed rows of steel and fabric chairs fill the space. For the most part the importance of these materials becomes apparent only in their formal arrangement—the formal cause.

[358] See Ibid., 50–51. for a fascinating explanation of the attack phase of timbre and "cut bell" experiments that demonstrate how the act of playing an instrument impacts its unique timbral quality.

they also observe each other's movements and the movements and attentiveness of the audience. Lighting can impact an audience's ability (whether actual or perceived as culturally regulated) to move about the space and observe one another.

It has been a chief argument of this dissertation that we must also acknowledge that smartphones now make up a large part of the material, formal, and efficient causality of live performance. Smartphones are rather complex devices. It will probably not be helpful to consider their material components beyond the high-level features that comprise these phones. These features include the light and sound emitting properties of phones. Both the front screen and the LED flash can be used as a light source; the phone speakers can, obviously, emit sound. Phone screens can also receive aural and haptic input through the phone microphone and screen, respectively.

Phones also receive and transmit radio signals, which when coupled with the formal use of those radio signals means that phones are “connected” devices. We should therefore not consider the material properties of individual phones in isolation. We can create an array of phones through network connections. Just as the material cause of a sculpture includes the *volume* of material used in forming it, so also the ubiquity of mobile computing impacts the material cause of phones in live performance. We can do things with hundreds of phones in an audience that we cannot do with a single phone in the audience. As discussed above, the array of phones in the audience can be lit or used to generate sound in unison. This introduced the issue of connectivity and network latency, which are physical, material properties of the technologies used to network the individual smartphones.

Network connectivity issues can usually be overcome with high-density Wi-Fi grids installed in venues, but these can be cost prohibitive and are usually not needed in smaller venues

(venues holding less than 2000 people by our measurements and research). Jazz performances, due to their generally lower audience numbers, are therefore ideal settings in which to use the Nymbus platform.[359] Large venues can be cued using ultrasonic cues that are picked up by phone microphones. However, phone microphones do not always pick up these signals, especially when high levels of ambient noise are present or phones microphones are covered by clothing or concealed in handbags.

These primary material qualities of phones—sound and light sources, touch and sound responsiveness, and connectivity via radio waves—all correlate, or align as I have been using the term in relation to intentional flows, with the material properties of live jazz performance. Sound is perhaps the most obvious of these correlations. Sound is overt both in jazz concerts and when emitted by a smartphone. Sound emitting from phones at concerts usually indicates an ill aligned use of the phone's connectivity; a party not at the venue is attempting to attract the attention of someone at the venue. The misalignment of intention results in the phone soliciting everyone's attention. However, if a phone's sound capabilities are shaped into a musical element that can be used by either musicians on stage or by the audience, then it becomes an overt extension of the sonic properties of jazz for the shared experience of everyone at the concert.

If, for example, a keyboardist began playing, but rather than sound issuing from a speaker on stage, it began coming from a phone in the audience, then the phone would literally be an integral part of the performance.[360] Furthermore, the connective properties of phones may be added

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[359] However, it should also be pointed out that larger venues are now recognizing the benefits as well as audience demand for connectivity during concerts and other live performance forms. Consequently, we are seeing more venues install high-density grids and new, cost-effective high-density connectivity solutions are coming on the market.

[360] Naturally, it would take a highly skilled musician to account for network latency, but one can imagine such a scenario. A version of this idea was in fact suggested to me during a conversation with local Pittsburgh jazz musician Pulsar Li. Li, Personal Interview on a Possible Test of the Nymbus Platform with Stranger Convention.

to this example, generating sound on all the phones at the concert. For this reason, cueing simultaneity across the array of phones becomes highly important to the design of Nymbus. As Levitin points out,

> Sounds that begin together—at the same instant in time—are perceived as going together, in the grouping sense. And it has been known since the time Wilhelm Wundt set up the first psychological laboratory in the 1870s that our auditory system is exquisitely sensitive to what constitutes simultaneous in this sense, being able to detect differences in onset times as short as a few milliseconds.[361]

Levitin points out that we use sonic simultaneity to identify and locate instrument groups in an orchestra. Thus, by creating simultaneous effects across an array of audience phones, we present the audience with affordances for action that use this same grouping function to create a shared sense of unity and identity. Not only must audiences download and open the mobile application, they have the opportunity to attend to their collective creation of music with the artists on stage.

Furthermore, sonic simultaneity across the array of phones also enables us to leverage group dynamics to create entirely new timbral qualities. Levitin explains that natural, acoustic instruments made out of wood and metal produce several frequencies of sound when they are played. Electronic sound generators are capable of generating tones at a specific frequency. Additive synthesizers combine multiple sound generators set to differing frequencies, thereby creating new timbres of sound through the blending of these differing frequencies. Levitin explains,

> I could have a bank of these generators making sounds at 110, 220, 330, 440, 550, and 660 Hz, which would give the listener the impression of a 110 Hz tone played by a musical instrument. Furthermore, I could control the amplitude of each of my generators and make each of the tones play at a particular loudness, corresponding to the overtone profile of a natural musical instrument. If I did that, the resulting bank of generators would

[361] Levitin, *This Is Your Brain on Music*, 77–78.

> approximate the sound of a clarinet, or flute, or any other instrument I was trying to emulate.[362]

Alternately, frequency modulation synthesis combines a basic waveform with an audible modulating frequency to produce more complex timbres. Both of these synthesis techniques could be applied to an array of phones to produce entirely unique, audience generated synthesized sound. Furthermore, by leveraging the accelerometer and gyroscopes of phones to determine the modulating frequency in a modulation synthesizer, the particular timbre of the audience synthesizer could be determined by the natural movements of the audience. This would provide additional affordances for interaction to the audience in producing the performance. These affordances, much like the parameters of jazz improvisation, would occur within the defined parameters of the generated base sound frequency, the sensitivity settings of the accelerometer and gyroscope, and the live cueing through the nLCC. Phone frequencies could be set to change with the chord changes. Thus, the new instrument, the audience synth, could be added to the palette of musical timbres in a jazz performance, and because audience behavior would alter the collective timbre of the instrument, each performance would be a unique improvisation. Levitin points out that even without changing notes we find pleasure in a change of timbre when a new instrument takes up the melodic line.[363]

Light functions in a similar way to sound on the Nymbus phone array. A single lighted phone screen or flash LED might distract one's neighbor from attending to the concert. But if that light is occurring across the audience and is informed by the musical structure of the currently playing piece (its formal cause), then it again overtly indicates participation in the performance. The above discussion of how sound can be manipulated both through live cueing and through

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[362] Ibid., 45.
[363] Ibid., 50–51.

audience movement and gesture venture into the formal and efficient causes of sonic effects. Similar types of effects and resulting alignment of intentional flows can occur through the manipulation of lighting effects on phones, but I will save that discussion for the sections on efficient causality below.

Sound, light, instruments, and the bodies of musicians and audience members in a jazz performance are material causes that impact the performance and its perception by audiences because of the shared space and time in which these material causes occur. My emphasis on the overtness of these causes in live performance has been meant to illustrate this point. Modern digital connectivity, on the other hand, lacks simultaneity of space and to some extent time. My emphasis on the sound and light emitting capabilities of mobile phones has been meant to illustrate their capacity to align with the overtness of live musical performance. But the architecture of the Nymbus platform is no less important in creating this alignment with the space-time continuum of a live performance.

As mentioned above, shared connectivity enables us to create effects that perceptually orient an audience to the performance space at a particular time. I would also argue that merely knowing that each phone in the audience is connected to the Nymbus server and is capable of receiving messages, pictures, polls, etc. from the band also orient the audience to the shared experience. If I receive a request to vote on the encore selection on my phone, when I see other audience members pick up their phone at the same lull in the performance, then I can assume that they too are casting their vote. To make this interaction even more overt, votes could be made to correlate with a particular color. Once a vote is cast, that phone screen assumes that color. A mere glance at my neighbor could tell me what song they would like to hear. Then after the votes are tallied, all phones would assume the winning song color.

This type of coordination of effects requires shared connectivity among audience devices and between the device array and the band, which the Nymbus architecture provides. A very important facet of MIDI cuing via a stage instrument is its demonstration of the one-to-one correlation between the material causes of instrument and phone array. The Nymbus architecture enables a direct, two-way material connection between instruments and phones. As improvisation on the stand requires shared material connections via light and sound as musicians actively attend to and respond to the playing of the rest of the ensemble, so also the material causes of the Nymbus system facilitate a similar type of interaction and improvisation. The next section will examine those interactions from the perspective of their efficient cause.

4.2.5.2 Ecology Directive Control (Efficient Cause)

In the prior section on the material cause and the object material of the smartphone, I discussed the phone's capacity to function as a sound and lighting instrument. In the next section, I will discuss the formal morphology of the phone as it is designed to be used with Nymbus and the live jazz environment. In this section, I will discuss the efficient cause, the "primary source of change or rest" in jazz and the Nymbus system.

Musicians and audiences are the efficient causes of jazz concerts. When considering efficient causality, it is easy to become distracted by all of the things that musicians *might* do in performance. As discussed in the example of the passive-dynamic walker, the child who plays with the toy may do a very wide variety of things with it, including destroy it. Similarly, musicians can do a variety of things with their instruments, including destroy them.[364] However, it was argued

[364] Indeed, the practice of destroying instruments has become so commonplace that a Wikipedia article has been devoted to "Instrument Destruction", which includes an anecdote of jazz musician Charles Mingus destroying his bass at the provocation of audience hecklers. Wikipedia Contributors, "Instrument Destruction."

that in the case of the passive-dynamic walker, destroying the toy was not among the actions that fulfilled its purpose or arose out of morphological relations between the toy and its environment. Similarly, we are concerned only with those actions which enable the musician to achieve the art of jazz performance as it has been recognized by experts in the field—those capable of understanding fine nuances and subtleties in the art form.

Nonetheless, the efficient causes wrought by musicians are diverse and include improvisation. How do we go about passive-dynamic interaction design creating a system that aligns or balances cognitive load between the materials, forms and efficient cause (or control systems when considered in terms of artificial intelligence) when the efficient cause is so diverse and improvisatory by definition? We saw that this is accomplished in the jazz ensemble by parameters within which agents were free to improvise. Efficient cause in live jazz performance is organized around maintaining the head, following an order of play, and improvising and comping within that established order. The head arrangement and order of play are formal causes of the performance, but how the musicians perform these parameters and improvise within them is of particular interest when studying the efficient cause.

In a highly informative article entitled merely “Music Performance,” Caroline Palmer examines an array of empirical research on what she calls the “expressiveness” of performer actions in musical performance. She particularly studies the cognitive mechanisms that contribute to a musician's nuanced interpretation of a musical piece and how listeners form expectations and interpretations of performance choices during a performance. Palmer writes that, “Performance expression refers to the large and small variations in timing, intensity or dynamics, timbre, and

pitch that form the microstructure of performance and differentiate it from another performance of the same music."[365]

While Western musical notation effectively represents pitch and duration information, intensity and tone quality are not well represented and musician use this lacuna in notation with small timing variations to add individualistic variation to a musical composition. For example, through timing, intensity fluctuations, and tone quality musicians create large group boundaries in a song's structure, organize metrical levels that are higher than measure, and create "patterns of motion, tension, and relaxation."[366]

For example, Palmer shows that melodic lines are emphasized through slight onset leads in relation to harmonic accompaniment.[367] She writes that, "Onsets of the melodic voice preceded other voice onsets [called melody leads]…Expressive timing patterns decreased when pianists attempted to play without interpretation, and these patterns increased in exaggerated interpretations…."[368] These performance variations in timing increased from novices to experts and through practice of an unfamiliar piece. Structural elements conveyed through timing, intensity and tone quality also impact improvisation. Musician improvisations on a melodic theme have been shown to retain the elements of the theme that have structural importance conveyed through these dynamic performance choices of onset, intensity and tone.[369]

Quite complex hierarchies and groups of organization are created through modulation of rhythm, dynamics and tonal quality. To explain, Palmer states that,

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[365] Palmer, "Music Performance," 118.
[366] Ibid., 119; Palmer, "Mapping Musical Thought to Musical Performance."
[367] These onsets are usually between 20 and 50 milliseconds. Listeners cannot identify the leading note of two notes that have an onset variation under 20 milliseconds. Palmer, "Music Performance," 125.
[368] Ibid., 119–120.
[369] Ibid., 123.

> Meter refers to periodic features: the regular alternation of strong and weak beats. Positions of metrical accents form hierarchical levels, with different periodicities represented at each level. Meter provides a temporal framework in performance for when to do what, as supported by evidence that only those rhythmic patterns that can be accommodated to a metrical framework are correctly reproduced…Grouping refers to the segmentation of a sequence into smaller subsequences that also form hierarchical levels, based largely on pitch relationships…phrases are thought to be the most salient level of grouping structure.[370]

Decreasing tempo and dynamic changes at the most salient levels of hierarchy and grouping are two of the most well documented examples of boundary marking by musicians. Through a hierarchical analysis of meter and grouping patterns, research has demonstrated a temporal relation between the relative importance of a musical segment and the degree of slowing just before its end boundary (what is known as phrase-final lengthening). Musicians give greater degrees of lengthening to the important segments of a work, and audiences also correlate phrase-final lengthening to musical meaning.[371]

Studies have also demonstrated that audiences identify these specific performance choices by artists as the source of musical expressivity. Unsurprisingly, listeners who themselves have musical experience (practical knowledge) have a higher degree of awareness of specific performance choices that convey the intentionality of the performer.[372] Palmer specifically argues that the musical structure, emotion and physical movement conveyed by variations of timing, intensity fluctuations and tonal variation form the basis of the meaning of music.[373]

I have argued in the prior chapter that the intentional flows and relations between flows in performance action that Palmer claims to be "interpretative" and "expressive" are not in fact

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[370] Ibid., 19.
[371] Ibid., 23.
[372] Ibid., 120., 124.
[373] Ibid. Emotional content is specifically linked to narrative through "…dramatic characterization, thematic content, and conceptions of large-scale structures."

expressive. The expression of intention occurs through a propositional articulation of these flows. This is why it is difficult to say *what* an artist expressed or meant in a particular performance. The performance is intentional, highly intentional, but it is not expressive. If the performance were expressive, then saying *what* it expressed would be merely procedural. Our expression of the intention in a performance is a propositional translation or elaboration or interpretation of what the artist has done.

To illustrate this point, reconsider the example given in the prior chapter of the guest drummer who signaled to his fellow musicians that he was a trained jazz musician. The drummer's press-roll between the head and the first solo (a structural marker) demonstrated to the other performers that he had a knowledge of jazz history. According to the drummer, the other musicians subsequently "…played their asses off."[374] That spirited description of what the musicians did is not actually what happened. What happened pertains to the intensity, tone quality, group boundaries, rhythmic patterning around the beat, and tension and relaxation in the harmonic rhythm. "Playing one's ass off" is an expanded description of those intentional flows as they altered the expected intensity, tone, rhythms and harmonies that might occur in a merely perfunctory rendition of the head arrangement. The musicians merely did what they did; expressions of what they did could doubtless fill volumes of subtle action analysis and the relations of those actions to a host of shared knowledge of jazz style and historical reference.

Despite this difference of opinion about how musicians express themselves, I agree with Palmer that musicians manipulate important relations between the structural, dynamic and tonal aspects of music that contribute significantly to the meaning-making process of musical performance and reception. We must recall that intention and expression of intent go hand-in-hand,

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[374] Berger, *Metal, Rock, and Jazz: Perception and the Phenomenology of Musical Experience*, 97.

as was argued in Chapter 2. I also affirm Palmer's emphasis on the importance of the hierarchical structure found in these “ambiguous” relations in music. Hierarchies of rhythm, dynamics and tonal qualities, important components of the formal cause of music, can guide the directive control or “efficient causality” of musicians. In the case of improvisation, it appears that a song's structural hierarchy created through variations of timing, dynamics and tone quality is a crucial distribution of cognitive load that lessens the conscious, directive control throughout the improvisational process. By maintaining behaviorally the important structural features, musicians are free to foreground other elements of their improvisation that require the generation of new melodic or harmonic material.

Considered as a whole, efficient causality in live jazz performance is highly complex. However, Palmer shows that timing (delay and anticipation in rhythmic structure and melodic leads), shifts of dynamics, and tonal quality and timbre provide the primary method of accentuating the musician’s particular contribution of efficient causality. These components enable musicians to create structural hierarchy and order within the piece of music and it is also what audiences attribute to musical intentionality (Palmer's “expression”). Timing, dynamics and tonal quality, importantly, distinguish human performance marked by identifiable individuality from merely mechanical or perfunctory human performance.[375]

But the challenge for this project arises in adequately creating an alignment of intentional flows between the efficient cause of jazz performers and audiences using smartphones. Specifically, we are looking for a type of balance of efficient causality in the Nymbus system that is similar to the balance of efficient, formal, and material causality in jazz performance. Since efficient causality in jazz performance particularly accentuates the hierarchical structure and

[375] Palmer, “Music Performance,” 120.

organization of the musical composition, the Nymbus platform should similarly seek to provide potentials for action that accentuate this structure. Additionally, the interactive dynamics of jazz ensembles should not be overlooked in the design of the system. This facet of jazz performance provides a compelling argument for a participatory, interactive design of the Nymbus platform, and I will offer further arguments for audience interactivity below. Jazz interactivity is also improvisational and the Nymbus platform should reflect this. Much improvisatory interaction of the jazz form depends on its formal, structural components, but improvisation nonetheless opens up space for musical exploration and potentials for errors when the form is lost.

Beginning with the structure and organization created by the efficient causality of jazz musicians, there is much that the Nymbus platform can do to parallel this causality in lighting, sound, text, and images. I argued at the introduction to the previous chapter that music visualizers hold limited potential in creating synesthetic mappings of intentional flows between aural to visual faculties. Much of the failure of these mappings arises out of the attempt to identify fine-grained features of musical compositions through fast Fourier transform algorithms. However, Palmer shows that the high and intermediate levels of rhythmic and melodic hierarchy and organization reveal a greater degree of musician control in performance. Furthermore, hierarchy and organization facilitate musical action within the ensemble as a whole. For example, it was shown in the previous chapter that jazz musicians improvise within a standard AABA format and follow a fairly regular order of play. Consequently, while a fine-grained one-to-one correlation between the intentional flow of music and effects on phones would quickly become an unnecessary and possibly distracting addition to a performance, at a less granular level aural and visual synesthetic mapping can prove useful.

This extraction of more relevant, high-level components of intentional flows within music also correlates to the structure of intentional action proposed in Chapter 2. To explain, following Aristotle and Anscombe, I argued for a hierarchical conception of human action. One action is done for the sake of another action, which in turn is done for the sake of yet another action. This string of actions, or action tree, arises out of the tight explanatory connections between actions. A later action within a series of actions provides an answer to the question "Why?" of a prior action within the series; the prior action answers the "How?" of a subsequent action. Within this teleological structure, we can identify segments of action. For example, pumping is a section of action; filling the cistern is another. Similarly, a jazz ensemble plays a series of notes in order to play a melodic theme, repeats the theme, introduces a bridge or variation on the them, and then returns to the theme. Each of these identifiable parts taken together compose the entire AABA structure, which is a structural element important to the compositional whole and improvisational dynamics of the ensemble. Alternately, the rhythmic pulse provides the basic structure, which can be varied in timing and emphasis to create more complex rhythmic patterns and segments.

Using smartphones as lighting instruments, we can easily set the phones to flash their screens or LEDs in time with the tactus of the music. This is a fine-grained visual effect similar to the synesthetic mapping of music visualizers; it similarly has limited appeal as an augmentation to the musical experience. However, lighting effects can be designed to communicate musically efficient causes at a higher level of intentionality. For example, instead of merely matching light flashes to the musical tactus, light and color fades can be used to mark measures and bars. Perhaps the first bar of music could correspond to a red fade, the second a blue fade, the third a green fade, and so on. This fade sequence, while illustrating a higher level of rhythmic hierarchy, would nonetheless be too fine-grained to serve as a helpful synesthetic device. However, progressive

segments of the song, musical themes, or instruments can be similarly marked with differing color pallets or textural image overlays that become prominent when those features become musically foregrounded. For example, press-rolls marking segment transitions could be accentuated with rapid flashing of phone LEDs. If certain effects are tied to a musician in a sequence following the AABA chorus structure of an improvisation, repeating these effects could point out when a musician has decided to improvise for an additional chorus. A skilled lighting designer in collaboration with a musician could doubtlessly devise even better effects, but the principled approach of identifying action and creating interactivity defended in this dissertation should inform that design process. A designer should understand how these design choices have guided the building of the Nymbus platform. Furthermore, a complete interactive show design uses platform capabilities beyond lighting effects.

Text messages to the audience could also be used to mark major structural boundaries or grouping in a song. In fig. 4.19, which displays the nLCC, text messages are used to introduce improvisation by Bill Evans and John Coltrane. Similarly, artists could use the multiple-choice polling feature of the app or the open-response text message feature to ask the audience what they hear in the music.[376] Musicians could then create improvisations based on the real-time responses of the audience.

Berger relates how some of the jazz musicians that he interviewed would often sing (out loud, quietly to themselves, or mentally) to keep their mind focused on the song that they were playing. For a similar reason, we plan to enable audiences to display the lyrics of the currently playing song by tapping on the appropriate set list item displayed in fig. 4.9. First iterations will

[376] "What do you hear?" might not quite be the best question. Perhaps, something more directed such as "Where did you first hear this song?" or "Bill is having a little conversation with Louie now." Here I reveal the limits to my palette of suave social interactions; I imagine that many jazz performers do not suffer from such limitations.

merely display the lyrics, but later versions scroll lines as they are played in the song. The current design of the Nymbus platform presents quite a bit of flexibility while also attempting to guide interaction design choices to reflect these principals of appropriate hierarchy and structured order. However, there are many improvements that can be made.

One such improvement is eliminating latency or rendering it non-distracting. Because we want shows to be cued in real-time with the maximal flexibility for performer improvisation, latency may prove to be somewhat problematic. If a song is programmed with set cues and played according to that program, then the light show can be perfectly synchronized with the music by accounting for latency during the "count in" to the downbeat. However, if an improvising musician decides to take another chorus, then that chorus cue would have to be repeated on the nLCC. It is likely that we can maintain the tactus of the song and keep effects in sync with the music, but there would most likely be a slight delay as the mobile clients receive and process the new cue. Installing a local server and Wi-Fi grid would most likely effectively eliminate latency, but this has yet to be tested.

We also have plans to improve the design and cueing consoles (nEDC and nLCC). The current designs make significant advances toward show design that fulfill our design objectives. Particularly, the focus on cues and effect sequences that can be easily copied and re-used enables designers to think in terms of "blocks" of interaction. A block could, for example, be a segment of the chorus or the entire chorus. But workflow of the design console nonetheless currently focuses effect states within cues and does not actively encourage designing at appropriate levels of granularity. Ideally, the design console should encourage designers to identify higher-level segments of songs and easily convey the musical breaks in a design. We will also include beats-

per-minute functionality so that instead of designing against clock time designers can work in terms of a song segment count.

Future designs will attempt to implement a linear song timeline with verses or choruses clearly marked. Ableton Live is a popular electronic music cueing software used by bands in live performance that incorporates some of these principals of hierarchical ordering of song segments (see figure 4.20).

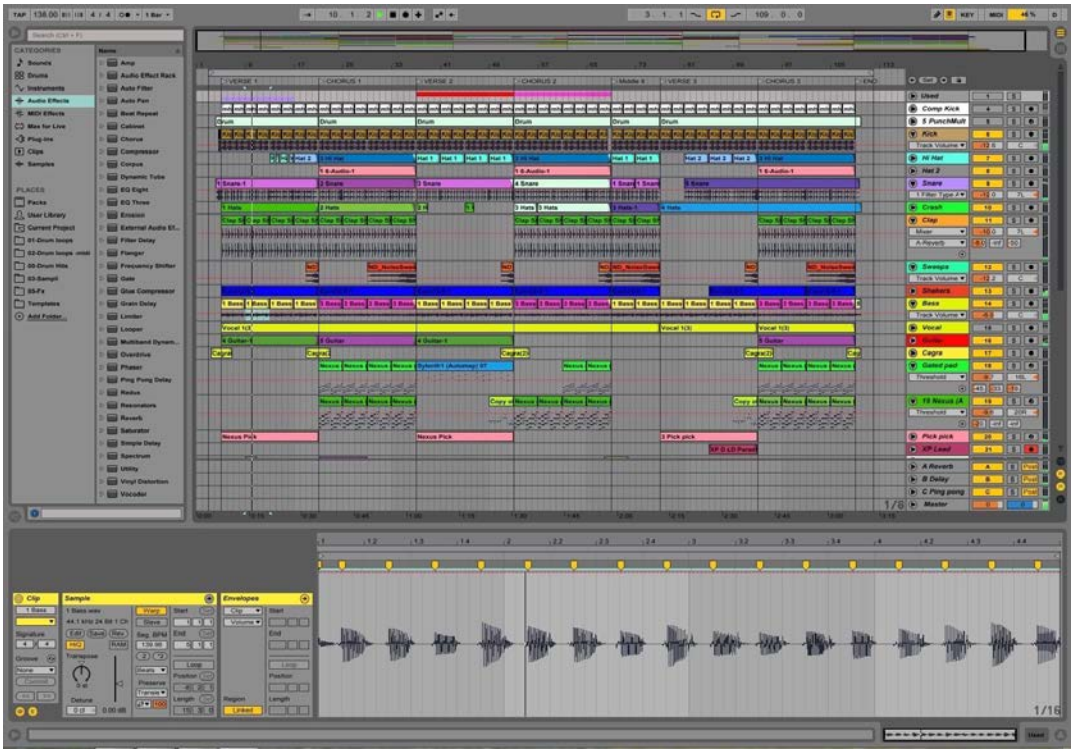

Figure 4.20: Screenshot of Ableton Live 9 Illustrating the Use of Verse, Chorus, and Measure Breakdown; Timeline; and bpm Delineation.[377]

Rather than selecting and playing a cue, musicians or crew members could select a song segment such as a chorus and easily visualize the various effects set to play in that song segment. As a first step toward this functionality and to efficiently test live cueing by song hierarchy, we

[377] Arson, "Review: Live 9 Suite by Ableton."

plan to build a plug-in for Ableton Live that will enable us to trigger cues in Ableton Live and link those cues to the nLCC. This may in fact be the preferred method of cueing for bands that already use Ableton Live in performance.

Currently, all of the interactions on the Nymbus platform, sonic, visual, text based, etc. occur without reference to spatial location within a venue. We can limit the interactions to a single performance at a single venue, but we cannot, for example, create lighting or sound effects in one half of the audience or only in specific locations in the audience. Audience phones are a homogenous array in which we can create uniform or random effects, but we cannot yet spatially locate individual or groups of phones in the audience. The reason for this is that indoor spatial location of thousands of devices is a difficult problem to solve. GPS location data generally lacks the accuracy needed for interesting audience-wide spatial effects, and accuracy is further degraded inside buildings. There are solutions on the market and in research that locate phones to within sub-meter accuracy and we anticipate implementing them in further versions of the platform.

With highly accurate location data we could create waves of sound and light across the audience coordinated to on-stage performance patterns. For example, an electronic keyboardist could set up a note in one part of the audience by playing it on the keyboard and motioning to that section of the audience. He could then set up additional notes in other segments of the audience creating a combined chord effect. The audience could then modulate the timbre of these notes or fluctuate between notes in the chord through simple gestures with their phones. Thus, not only would the Nymbus platform enable interaction between audience and performer(s), audience members could interact musically with on another.

Similar effects and interactions could be created with light. Patterns of light in the audience could reflect the relative energy of the performers (measured by volume or perhaps with a

Microsoft Kinect). Performers could play specifically to segments of the audience, which would be reflected in lighting patterns in the audience. Alternately, a single member of the audience could be serenaded (or called) and their presence in the audience could be emphasized by lighting their phone in one color and surrounding them with a pool of light from adjacent phones. The number and types of interactions multiply when precise spatial location capability is added to the Nymbus experience.

In this section I have predominantly focused on the way that cue stacks can be created to direct audience attention to the efficient causality of a live performance, but there are also important facets of the balance between efficient, formal, and material causality in the Nymbus emphasis on real-time live cueing and in the interactivity we have enabled in visual and aural effects on audience phones.

Jazz improvisation can happen in a number of ways. It can happen on the bandstand, but it can also happen in conjunction with the audience. In Chapter 3 I discussed some of the structural features, practical habits, and environmental considerations that go into an improvisation by a musician. In the prior section on material cause, I argued that improvisation, as an essential feature of jazz music, should be reflected in the material design of the Nymbus system. This led to the open-ended, sandbox design of the system as well as the emphasis on live cueing via the web application or MIDI input from musician's instruments. Improvisation happens in jazz as artists work within parameters. We have attempted to create the Nymbus platform with similar parameters that provide potentials for action and interactivity without overdetermining those actions. The emphasis on live cueing in the nLCC is an example of this. Artists must have the freedom to make performance choices without being confined to an ordered flow of the cue stack. Consequently, we have expended significant time and resources to create synchronization across the platform,

minimizing cue data to overcome the physical limitations of cueing hundreds to thousands of phones in real-time. We are working to eliminate the friction between what an artists does on stage and the effects and interactions created in the audience.

We have allowed the live creation and immediate cueing of a class of effects (messages, picture messages, polls and merchandise offers) because we deemed these interactions simple enough to create and cue as the need or desire arose. Other effects, such as lighting and sound effects, must be created in the nEDC before a show begins due to the tediousness of creating these types of effects. Interactions created mid-performance can also receive input response from the audience. We compile and include these responses in the right-hand status feed of the nLCC so that artists and show crew members can see these responses with a mere glance at the screen.

The efficient causality of improvisation and interactivity is also reiterated in the responsiveness that can be assigned to audience-wide visual and aural effects on the Nymbus platform. Musicians provide the efficient cause of musical sounds in jazz. The formal and material properties of instruments highly impact their responsiveness to musician action, but it is the art of the musician that is the primary source of change or rest. Consequently, improvising musicians must have expert skill and knowledge of the responsiveness of their instruments. Furthermore, Palmer argues that improvising musicians tend to retain only structurally important aspects of a theme and audiences also anticipate these retentions in an improvisation. Thus, by giving audiences the ability to improvise on an aural or visual correlate of the musical performance, they too can transfer attention to important structural features into action.

For example, by allowing audiences to determine the modulation or timbre of a tone on their phones, they might more closely attend to the musicians who are improvising off of that tone. Alternately, creating a flash pulse on phone screens that matches the drummer's use of the high-

hat but that also responds to a finger tap by the audience, might help audiences attend more closely to polyrhythmic aspects of the drummer's performance. We do not assume that we can re-create a musician's experience for an average listener. What we might be able to do is create action potentials that coordinate with musical performance choices with the goal of accentuating attention in the audience.

Of course, there is much work to be done to test and prove this hypothesis. We have attempted to design effect interactivity on the Nymbus platform to leverage current smartphone's responsiveness to efficient causes to as great a degree as possible while also providing necessary parameters (such as the threshold concept) for this responsiveness. There are undoubtedly better ways to do this that will become evident through experimentation. Other solutions currently available for audience interactivity in live concerts do not present as high a degree of device responsiveness to audience gestures.[378] Consequently, we believe that our interactive design choice represents a step in the right direction. Further research in electronic music performance could greatly improve our efforts.[379] In the next section, I explore in more detail some of the formal causality alluded to in this and the prior section.

4.2.5.3 Ecology: Object/Environment Morphology (Formal Cause)

Many of the elements of formal cause in the Nymbus design relative to live jazz have already been discussed in the above sections on material and efficient causality—such is the nature of interrelations and dependencies of the various causes. I argued earlier that of Levitin's seven

[378] See for example, Xyloband "LED Wristbands and Wearable Technology Products"; Glow Motion, "Glow Motion Technologies Homepage"; PixMob, "PixMob Homepage"; Wham City Lights, "Wham City Lights Homepage"; inConcertApp LLC, "Amp'd App."

[379] See for example, Mailman, "Improvising Synesthesia: Comprovisation of Generative Graphics and Music"; Machover et al., "Hyperinstruments."

“major elements” of music, pitch, rhythm, melody, harmony, tempo, meter and loudness, all but pitch and loudness demonstrate formal properties in their complex patterning and relationships among sounds. Palmer's emphasis on hierarchies of rhythm, dynamics and tonal qualities in large part refer to a musician's formal shaping of sound. Following Anscombe in Chapter 3, I argued that the musician's practical knowledge of musical performance is the *formal* cause of what she knows; practical knowledge entails a knowledge of how to create rhythms, dynamics, melodies, tempos, meters, dynamics and otherwise shape the material of sound into music.

Form factors of instruments were also briefly mentioned above as crucial controls in musical performance. Closer study of these formal factors and the impact on efficient cause in performance could doubtlessly improve design of audience interactive manipulation of visual and aural effects on mobile devices. For example, a drum kit assembles certain resonate properties that musicians use to carry differing portions of the groove (discussed in Chapter 3). Future developments of the Nymbus platform could measure movement through smart watches and mobile handsets to determine if interactor movements follow similar patterns of complex, rhythmic coordination. This type of measurement might only be effective if the interacting audience member is dancing.

In the prior sections I also examined some of the formal arrangement of the Nymbus platform as a whole. System architecture sought to achieve a large degree of flexibly through internet protocol connectivity, cloud-computing services, possible use of a local server, and MIDI integration of instruments and lighting boards. The benefits and limitations of these design decisions need not be reiterated.

Transitioning from an effect-based architecture to a cue-based architecture is also as much a formal consideration in its organization of data as it is a design for alignment of efficient causes

in performance. However, interactive effects have their own formal considerations. Lighting up a phone's LED and making it flash in time with music requires a knowledge of the song's beats-per-minute. Designing lighting fades to match a song's intro, head arrangement, chorus structure, order of soloists, etc. is also an attempt to shape lighting effects to the musical structure of a performance. On a single phone lighting effects have highly limited formal promise, but distributed across an audience of phones, lighting effects have the potential to extend moods created in sound into unifying visual experiences. Spatially locating phones similarly improves the intentional impact carried by light and sound effects by improving the formal capability of these effects as they are spatially oriented across an audience.

Audience-wide sound and lighting effects may be designed to reiterate the formal factor of many musical elements in a jazz concert. However, they also introduce entirely new and distinct variations on those formal causes in the jazz experience. While there is lighting at concerts, audiences do not hold the lighting instrument. Similarly, the traditional jazz ensemble is formed around the front line lead instruments and supporting bass, piano, and drums. Enabling musicians to play phones in the audience and allowing the audience to play with the sounds on their phones introduces a distinct break of the formal structure of the ensemble. A distributed audience synthesizer introduces a form factor that has yet to be proved. This design choice is based on the collective format of live performance, but these effects might diverge enough formally from current jazz performance to result in experiences that emerge upon rather than extend jazz experience.

Other form factors have been alluded to in the above discussion of the Nymbus design but not yet directly addressed. Event organization and concert format are of particular interest. The jazz concert circuit is highly complex and diverse, which means that concert formats are also

diverse. Formal concerts, such as those presented by Pittsburgh's MCG Jazz, may be booked by an independent band or by a band manager.[380] Alternately, a venue or presenting organization might set a date and solicit a main act for that date. Additional acts are sometimes added by the venue, promoter, or headline act. The event is then promoted. Tickets are sold either through the venue or through a separate ticketing organization. The audience arrives, additional tickets are sold or retrieved from will call. The audience enters the space, shows their tickets, receives a program and is assisted in finding their seats, assuming the event is not general admission. There is often an introduction of the concert and band, sometimes by the presenter or by an opening band. The ensemble lead frequently provides an introduction to many of the numbers. Band members are formally introduced at some point in the concert. There may be an intermission. Requests are taken. A final number precedes one or more encore sections, and the concert ends.

These events comprise a common concert form, but there are other forms. Jazz ensembles frequently play for patrons of restaurants and at festivals. These formats vary from the standard concert form, but many of the primary formal components are the same. When designing the Nymbus mobile application, we mapped many of these formal features of the concert experience directly onto the app's user experience flow. Following the splash screen that displays when the app opens, users are presented with a list of events near them. After selecting event, they see the list of artists performing at the event and the timing and order of their performance (or the slot list may contain only a single artist). Users may select an artist from the slot list to open the artist profile where artist program notes can be displayed along with other online content. Set lists are populated as the band plays, and the messaging feature already discussed can be employed at the band's discretion. Thus, the concert flow is mirrored in the app.

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[380] MCG Jazz, “MCG Jazz.”

The ability to create a conversation with the audience via the mobile app will need to be closely monitored so that it does not disrupt direct, spoken communication between musicians and audience members. Musicians should be encouraged to only offer communications via phones that could not or would not otherwise be given directly. Given their practiced sensitivity to interactions with the audience during a performance, we anticipate that musicians will effectively monitor their use of the messaging feature. Mid-performance communication might in part be determined by the venue and event format. For example, direct, spoken communication can easily occur at a formally staged concert, but restaurant patrons and festival attendees come and go sporadically and must attend to a variety of non-musical aspects of the event: where to sit, what to eat, etc. In these venues, subtle push notifications can be used to overcome the limitations of sound systems to convey stage announcements or to inform patrons of performance choices by the ensemble.

Formal causality in live performance presents numerous challenges. Particularly in improvisational performance, the form changes frequently, but there the constants may be identified and leveraged in the design of an interactive technology. I have attempted to show how our sandbox design of Nymbus opens up enough creative space to accommodate the formal requirements of live performance while also putting enough constraints in place to help facilitate interactions that compliment the live experience.

4.3 AN ENDING WORD ABOUT EMERGENT FINAL CAUSES

I set out at the beginning of this dissertation to identify the flows of intentionality in live jazz performance and map those flows onto the design of the Nymbus system. From the outset it was apparent that introducing a new technology, especially an interactive technology, into a live

performance would doubtlessly change the dynamics of that performance and lead to unpredictable emergent properties within it—a new hybrid art form might emerge.

I argued in Chapter 2 that when engaging in practical rationality, the end, or objective, of the practical syllogism must also be its beginning, albeit assumed and set off to the side of the formal logic within an action. But if practical rationality proceeds correctly, then the objective goal is also the end that is derived from that reason. Thus, two horns of a dilemma appeared to inhibit my argument. On one side of the dilemma an emergent art form was the end sought, but an emergent art form cannot be known until it emerges. On the other side of the dilemma, that emergent end must stand tacitly assumed as the starting point of any practical syllogism constructed to achieve it. I believe that this is the dilemma that user experience designers frequently confront when they describe a "leap" that must occur between the collection of research into a problem and the design that mysteriously "arises" out of that research.

In this chapter, the solution I proposed involves a careful study of the material, efficient, and formal causes because these causes provide us with the answer to the "Why?" of any system of action and interaction. By attending to these causes of the source domain (jazz performance) and mapping the passive-dynamic relationships we discover in that domain onto the same causal categories we create in the new technology, we stand a much greater chance of arriving at an emergent target domain (the End of our design) that fulfills or extends the teleology of the source domain. The substance of this argument is philosophical, and I am comfortable with a logically substantiated philosophical proof. In fact, that may be the best proof of which we are capable when it comes to extending teleologies.

5.0 CONCLUSION

I began the research to this dissertation by writing an initial, hefty prospectus that turned out to be a false start. I had attempted to fashion an approach to theatre and performance using Donald Davidson's theory of action coupled with work by philosophers Anthony Kenny and Nicholas Wolterstorffe. The result was interesting (at least to me), but it was a muddled mess. As scholars often do, I continued to follow this glimmer of interest and cast about in the waters of philosophy and cognitive science of action. Eventually treading cautiously into the secondary literature on Anscombe's philosophy of action (I had been warned to steer clear of the complexities of her *Intention*), I discovered her consonance with models of embodied and extended cognition that have found increasing acceptance in theatre and performance studies. Her work also altered my approach to the integration of action theory with user experience design. Rather than focusing on a propositional structure of action that hinged on the acquisition of beliefs and desires, which can be mapped onto conceptual models of task design, Anscombe's model explains task design while also holding powerful explanatory potential for current work on the emotions, affordances, storytelling and open-ended interactions in design.

Undoubtedly sharper and more experienced scholars could have arrived with greater ease and speed at the approach to user experience design that I have defended in this dissertation. However, I have no doubt that more accomplished scholars would also agree that the time and patience required to unravel these types of conceptual knots is to some extent unavoidable. I hope that I have succeeded in showing why we should not forego the expense of this time and patience. I believe that theatre and performance as well as user experience design have much to profit through careful discussions of challenges within each discipline on action theoretic terms. But

there are also broader social, cultural and (though I dislike going here) political reasons to further pursue this discussion.

Much has changed since I began this dissertation. In the time that it took to make the argument that action theory has useful things to contribute to theatre and performance studies and user experience design, the Google Glass developer's program has started and ended with rumors that a new version of Glass is under development. Wearable technology, such as Apple's highly successful Watch and Microsoft's HoloLense, is projected to grow 400% by 2017 with 700 million projected shipments of these devices.[381] Facebook purchased Oculus VR for $2 billion in order to fulfill the Facebook mission of making the world "more open and connected." Facebook CEO Mark Zuckerberg explains,

> When you put [the Oculus Rift virtual reality headset] on, you enter a completely immersive computer-generated environment, like a game or a movie scene or a place far away. The incredible thing about the technology is that you feel like you're actually present in another place with other people. People who try it say it's different from anything they've ever experienced in their lives. Oculus's mission is to enable you to experience the impossible.[382]

Zuckerberg goes on envision other "face-to-face" experience (he mentions a sports, classrooms, and doctor's visits) that can be had "…just by putting on goggles in your home." Given that the video gaming revenues have outpaced film for several years, we should not overlook the potential influence of virtual reality headsets on human perception and experience.[383] Zuckerberg's claims

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[381] "How Many Wearable Devices Are There?," *American Banker*, December 30, 2014, http://go.galegroup.com/ps/i.do?id=GALE%7CA395243112&v=2.1&u=upitt_main&it=r&p=AONE&sw=w&asid=ac4bc81c2290f15f74b3fd44c535413f.

[382] Mark Zuckerberg, "Announcement of Facebook Acquisition of Oculus VR," *Facebook*, March 25, 2015, https://www.facebook.com/zuck/posts/10101319050523971; Kyle Orland, "Facebook Purchases VR Headset Maker Oculus for $2 Billion [Updated]," Ars Technica, March 25, 2014, http://arstechnica.com/gaming/2014/03/25/facebook-purchases-vr-headset-maker-oculus-for-2-billion/.

[383] Tom Chatfield, "Videogames Now Outperform Hollywood Movies," *The Guardian*, accessed April 29, 2015, http://www.theguardian.com/technology/gamesblog/2009/sep/27/videogames-hollywood.

should give us pause. He states that Oculus both "…makes you feel like you're actually present in another place with other people…" while also reporting that its different than anything ever experienced in life. Either the people who have tested Oculus have never experienced being "actually present in another place with other people" or the Oculus experience is indeed different than anything experienced in life, in which case, the reports are false.

Following Aristotle's intentionalistic theory of mimesis, I have argued that our technical activity, or making, involves a shaping of material existence to convey a possible world that does not exist until it is instantiated through our act of creation. Mimesis is the enforming of the material of an art form through the efficient cause of the artist. The logic of this act arises out of the teleological relations of the individual acts that comprise it, the material with which one acts and the affordances for action presented by that material, and the ecological context within which one acts. However, I have also argued following Anscombe that the meaning of these acts is not entirely derived from the internal teleological structure of the actions. Actions do *not* express meaning. Rather, the meaning of an action arises through a "break" in the teleological sequence of acts, which occurs when we provide an expanded description of that action.

In Chapter 3, I argued that our experience of the intentional flows in artistic creation cannot be accounted for solely in structuralist terms or in terms of how artistic actions function within society. Rather, our experience of human art is itself an active process that involves a feedback loop between perception and action within an ecological context. Furthermore, because artistic actions underdetermine their meaning, audiences must determine that meaning through their own enactive experience and through the positing of expanded descriptions of those experiences. Because practical knowledge, knowing how to do something, must appeal to prudence, knowing *what* to do, for its direction, which is a knowledge of the end of an action (its expanded

description), knowing what to do arises out of knowing why to do it. Because we are embodied creatures who act within an ecological context knowing why to do something (the meaning of our actions) can be in part derived from that context. Jazz performance presents the musician with a clearly defined ecological context, but it is this context that, by design, underdetermines which actions that the musician will choose. Jazz presents certain potentials for action, but leaves it up to the musician what to make of it. It is this unique design that creates the teleological trajectory of the art form and brings into existence the world of jazz.

The challenge of emerging technologies is that we do not know exactly what world they will bring about. As I argued in the case of music visualizers, the potentials for experiential action presented by that particular technology severely lessens the intentional flows that comprise music as an artistic creation. I suspect that the Oculus virtual reality headset does the same thing in a much more intrusive way for visual experiences.[384] These are perceptual examples of technological truncation of experience, but new technologies also impact the potentials for action and interaction that are possible. If Oculus alters interaction in virtual space in the same way that Facebook has altered (primarily) textual social interaction, the outcome will not lack problems. Furthermore, because of the relationship between action, perception and teleology, these new technologies are unavoidably creating new teleologies for those who use them. Whether or not these teleologies will bring about human flourishing is a matter for prudential discernment.

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[384] In fact, a video describing the latest model (Developer Kit 2) of the headset released by Oculus, explains that the headset uses a "low persistence" display in which the display goes dark between frames. When combined with a high frame rate, this feature eliminates blur or jitter in the image as the wearer moves within a virtual environment. I do not understand the full technical implications of this feature or its relation to saccadic masking or chronostasis, however, we do know that the actual world does not periodically "black out." This means that the introduction of low persistence is a technical trick of our perceptual system. See *Oculus Rift Development Kit 2*, 2014, https://www.youtube.com/watch?v=OlXrjTh7vHc&feature=youtube_gdata_player.

This issue of prudential discernment is precisely where the research presented in this dissertation borders on ethical concerns. I would hardly propose that in order to escape undesirable teleologies we abandon technological development. This is Luddism, and I believe I have shown myself to not be a Luddite. What I do propose is measured reflection on these teleologies. We may pursue this reflection through teleological ethical systems, such as Virtue Ethics, or we may pursue it through a careful consideration of the causes that bring about the new technologies that we create. I have attempted this type of reflection on the Nymbus platform in Chapter 4.

As I mentioned above, video gaming has outpaced Hollywood in terms of cultural consumption. By my count, this would constitute the fourth time that live performance has been lapped by technological advance (film, television and the Internet being the other technologies that have overtaken us). However, as a parting salvo to both rally the forces and to support the argument that action works a deeper magic not easily replaced, the current music industry illustrates how technology is often its own undoing. Over the past fifteen years music industry fortunes have been demolished by the proliferation and easy distribution of digital music over the internet. Because of the intense competition within this frictionless distribution system, fewer recording artists are "breaking" than ever before. However, easily accessible digital music has had just the opposite effect on the live touring industry. The concert festival market has exploded and general concert attendance increased by about 19% in 2013. Ritually heading to the record store on the day of favorite artist's album release may have maintained a sense of participation in the life of that artist, in a cultural phenomenon, live shared concert experiences now appear to hold that sought-after sense of participation and belonging. Yet, it is an audience that now lives daily within an ecology of pervasive computing and virtual interactions. This is a moment of immense potential for those

who understand live action and lived experience in its most primal dimensions. It is a moment that invites the impact of live performance art on the current explosion of interactive technologies.

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