Lilacs: Digital Songs and Poems for Voice, Clarinet, Percussion, Electric Guitar, and
Electronics, and
Ethical Considerations for the Design and Documentation of Wearable Technologies,
Responsive Textiles, and Haptic Sound Art

by

Sarah Alena Curzi

Department of Music
Duke University

Date:_____

Approved:

_____

Stephen Jaffe, Co-advisor

_____

John Supko, Co-advisor

_____

Scott Lindroth

_____

William Seaman

[Thesis/Dissertation] submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
Music in the Graduate School
of Duke University

2020

<u>ABSTRACT</u>

Lilacs: Digital Songs and Poems for Voice, Clarinet, Percussion, Electric Guitar, and Electronics, and
Ethical Considerations for the Design and Documentation of Wearable Technologies, Responsive Textiles, and Haptic Sound Art

by

Sarah Alena Curzi

Department of Music
Duke University

Date:_____
Approved:

_____
Stephen Jaffe, Co-advisor

_____
John Supko, Co-advisor

_____
Scott Lindroth

_____
William Seaman

An abstract of a dissertation submitted in partial
fulfillment of the requirements for the degree
of Doctor of Philosophy in the Department of
Music in the Graduate School of
Duke University

2020

Abstract

This dissertation contains two parts: an original album for voice, clarinet, electric guitar, hand percussion, and electronics; and an article analyzing ethical use of responsive technologies in art, music, and design.

Lilacs: Digital Songs and Poems for Voice, Clarinet, Percussion, Electric Guitar, and Electronics is a musical work in twelve sections inspired by the experience of losing a loved one to cancer. Themes of healing, hope, loss, and grieving appear in several of the songs and poems. The texts are original, except portions of "The Promise" which were excerpted from Isaiah 43:2-5. The musical sections comment on the ideas in the main poem, "the words that should not be said," which is broken into four pieces. My music and text evoke an emotional process that is difficult to navigate: how to display a socially acceptable public face while privately grieving. Which words are "safe," and which words should be "held close to [our hearts]"?

In some ways, my work is similar to a 19th-century song cycle, which usually involved solo or ensemble voices and instrumental accompaniment[1] (especially the combination of voice and piano). Like song cycles in the 19th

---

[1] Susan Youens, "Song Cycle." Oxford Music Online. 2001; Accessed 18 Nov. 2019. https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.26208.

century, *Lilacs* is meant to be cohesive; the songs are meant to go together and comment on one another. In the context of this form, my choice to mix voice and choir is unusual, though there is a precedent in Schubert's *The Lady of the Lake.*[2] My choice to electronically overdub my own voice certainly departs from standard song cycles, which were most popular in a day where electronic manipulation was impossible.

Lilacs was conceived in an electronic format and is designed to be heard at home or on headphones, a listening experience which is not standard for song cycles or classical music as a whole, and relies on electronic devices as mediators of acoustic intimacy. The mix of styles, electronic format, and navigation of multiple music styles in *Lilacs* also suggest that this work is an avant-garde digital concept album in the same vein as The Beatles' *Revolver*, but the fragmented narrative provided by my original poems are reminiscent of theatrical monologue. Taken together, the elements of my work suggest that *Lilacs* asserts its own genre. The final track, "Branches," is submitted with the written dissertation, and can be heard at https://soundcloud.com/sacurzi/12-branches.

---

[2] Ibid.

In my article, I analyze four case studies of interactive art to show that existing projects can inform the ethical design, use, and promotion of current responsive art and commercial projects. While responsive technologies incorporate fields as diverse as science, music, fashion, medicine, art, and textiles, critical discourse on the cultural meaning of wearable electronics and responsive textiles has been limited, with most literature and scholarship focusing on the technological advancements themselves. As a result, creators and consumers of wearable technology engage with increasingly "modern" garments but only rarely interrogate their use.

I analyze the interactive artwork of Yuri Suzuki, Anna Biró, Alyce Santoro, and Joanna Berzowska. First, I demonstrate the ways in which these artists disrupt dominant power dynamics of gender, ecology, disability and globalization; based on these analyses, I then develop a table of ethical considerations for the design and documentation of responsive textiles and haptic sound art. I intend this table be a practical tool for creators of responsive technologies in art, design, and commercial applications. I hope that my research will affect decision-making regarding photographic styles for the purposes of advertising or (in the case of artists) public documentation, which currently promotes thin, white, cisgender women. My work also has tangible benefits for commercial applications, where ethical sourcing and labor can protect companies

from expensive lawsuits, loss of income from damaged brand image, consumer boycotts, and even embargos such as the United States suspension of trade with Bangladesh after the Rana Plaza factory collapse.

Contents

List of Figures

Acknowledgements

1. Introduction

This dissertation contains two parts: an original album for voice, clarinet, electric guitar, hand percussion, and electronics; and an article analyzing ethical use of responsive technologies in art, music, and design.

Lilacs is a musical work in twelve sections inspired by the experience of losing a loved one to cancer. Themes of healing, hope, loss, and grieving appear in several of the songs and poems. The texts are original, except portions of "The Promise" which were excerpted from Isaiah 43:2-5. These texts comment on one another and are meant to be understood in tandem. The main poem, "the words that should not be said," is broken into four pieces. My music and text evoke an emotional process that is difficult to navigate: how to display a socially acceptable public face while privately grieving. Which words are "safe," and which words should be "held close to [our hearts]"?

In some ways, my work is similar to a 19th-century song cycle, which usually involved solo or ensemble voices and instrumental accompaniment[3] (especially the combination of voice and piano). Like song cycles in the 19th century, *Lilacs* is meant to be cohesive; the songs are meant to go together and

---

[3] Susan Youens, "Song Cycle." Grove Music Online. 2001; Accessed 18 Nov. 2019. https://www-oxfordmusiconline-com.proxy.lib.duke.edu/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000026208.

comment on one another. In the context of this form, my choice to mix voice and choir is unusual, though there is a precedent in Schubert's *The Lady of the Lake.*[4] My choice to electronically overdub my own voice certainly departs from standard song cycles, which were most popular in a day where electronic manipulation was impossible.

Lilacs was conceived in an electronic format and is designed to be heard at home or on headphones, a listening experience which is not standard for song cycles or classical music as a whole, and relies on electronic devices as mediators of acoustic intimacy. The mix of styles, electronic format, and navigation of multiple music styles in *Lilacs* also suggest that this work is an avant-garde digital concept album in the same vein as The Beatles' *Revolver*, but the fragmented narrative provided by my original poems are reminiscent of theatrical monologue. Taken together, the elements of my work suggest that *Lilacs* asserts its own genre. The final track, "Branches," is submitted with the written dissertation and may be heard at https://soundcloud.com/sacurzi/12-branches.

In my article, I analyze four case studies of interactive art to show that existing projects can inform the ethical design, use, and promotion of current

---

[4] Ibid.

responsive art and commercial projects. While responsive technologies

incorporate fields as diverse as science, music, fashion, medicine, art, and

textiles, critical discourse on the cultural meaning of wearable electronics and

responsive textiles has been limited, with most literature and scholarship

focusing on the technological advancements themselves. As a result, creators and

consumers of wearable technology engage with increasingly "modern" garments

but only rarely interrogate their use.

I analyze the interactive artwork of Joanna Berzowska (in collaboration

with XS Labs), Yuri Suzuki, Anna Biró, Alyce Santoro. First, I demonstrate the

ways in which these artists disrupt dominant power dynamics of gender,

ecology, disability access, and globalization; based on these analyses, I then

develop a table of ethical considerations for the design and documentation of

responsive textiles and haptic sound art. I intend this table to be useful for

creators of responsive technologies in art, design, and commercial applications.

I hope that my research will affect decision-making regarding

photographic styles for the purposes of advertising or (in the case of artists)

public documentation, which currently promotes thin, white, cisgender women.

My work also has tangible benefits for commercial applications, where ethical

sourcing and labor can protect companies from expensive lawsuits, loss of

income from damaged brand image, consumer boycotts, and even embargos

such as the United States suspension of trade with Bangladesh after the Rana

Plaza factory collapse.

2. Lilacs: Digital Songs and Poems for Voice, Clarinet, Percussion, Electric Guitar, and Electronics

Lilacs

For voice, clarinet, electric guitar,
hand percussion, and electronics

2.1 Logistics

2.1.1 Duration
17 Minutes

2.1.2 Instrumentation
Voice

Clarinet in Bb

Electric Guitar

Percussion (doumbek (1 med., 1 large), finger bells, suspended cymbal)

2.1.3 Notes on the Recording
The instrumental tracks for *Lilacs* were recorded at Futura Productions, a

studio in Roslindale, Massachusetts, outside of Boston. The sound engineers

were John Weston (owner of Futura) and Frank Cunningham. Instrumental

recordings were performed by Amy Advocat (clarinet), Mike Williams

(percussion), and Dan VanHassel (electric guitar). I performed the spoken and

musical vocal work myself. I recorded the spoken poetry in Duke University's

Multimedia Project Studio and recorded the musical vocal material at Smith

Warehouse (also located at Duke). I edited the vocal and instrumental recordings

using Avid Pro Tools. The last track, "Branches," was created in Pro Tools using

air sounds from the clarinet, paper and other objects rubbing across the

doumbek, recordings of my breath, and Tibetan prayer bells.

2.2 Program Notes

Lilacs is a musical work in twelve sections inspired by the experience of losing a loved one to cancer. Themes of healing, hope, loss, and grieving appear in several of the songs and poems. The texts are original, except for portions of "The Promise" which were excerpted from Isaiah. The musical sections comment on the ideas in the main poem, "the words that should not be said," which is broken into four pieces. My music and text evoke an emotional process that is difficult to navigate: how to display a socially acceptable public face while privately grieving. Which words are "safe," and which words should be "held close to [our hearts]"?

2.3 Libretto

Texts for "the words that should not be said," "White Elephant," "secret words," "Little Tree," "cells," "Lilacs," and "one or two more weeks" are original text by Sarah Curzi. Copyright by Sarah Curzi, ©2019. Gray text not set.

"The Promise" is a mix of original text by Sarah Curzi and excerpted lines from Isaiah 43:2-5, English Standard Version (mod. Curzi).

2.3.1 Guitar Prelude
For solo electric guitar.

2.3.2 the words that should not be said
For spoken voice.

safe words are intended to be used
and spoken
or sung.

secret words
should not be spoken
or whispered
or thought
or written.

thirteen months ago
i discovered a new word
"cancer" that I do not speak
or whisper
or write.
it is a noisy word that crowds out other words.

2.3.3 White Elephant
For voice, clarinet, percussion, electric guitar.

You smell of tangerines and gold silk.
In your hair are tangled stars and a white elephant.

Through my window several bees
are drinking nectar from the redbud trees.

I've been here for several years and nothing feels like home.
Magnolia trees are strong and green
and spring comes sooner than I want it to.

Are there redbuds where you are going?
Will the landscape feel like home?

I saw a cluster of alpine flowers
and dry nestled grasses
sheltered behind a whale bone.

When you die, shall I take shelter behind your spine?
In your hair are tangled stars
and a wound that feels like home.

2.3.4 Clarinet Interlude

For clarinet solo.

2.3.5 secret words

For spoken voice.

i keep my hands in my pockets to keep the words that should not be said
quietly where they belong
but I may spill them easily

three months ago i discovered "palliative"
and slipped it quietly next to the others.

safe words include "fine" or "tired"
but do not include "gutted"
or "shattered" or "hollow."

for a time
i kept my secret words in my back pockets
until i ran out of space.

in my shirt pocket
quietly rest the extras
close to my heart.

five weeks ago i acquired "hospice," "morphine," and "oxycodone,"
which were shortly joined by "haloperidol," "death" and "dying."

2.3.6 Little Tree

For voice, clarinet, and electric guitar.

Fear not, little tree,
I will heal you.

Little tree,
you are as ill as me.

Little tree, what is eating you?
Why do your leaves curl?

Fear not, little tree,
I will heal you.

2.3.7 cells

For spoken voice.

"Food" used to be a safe word
but now it is a secret word
as you defend your right not to eat.

i understand that food is punishment
when you are being eaten by cells
that do not belong.

Even tap water is a dirty phrase -
all water must sparkle.

2.3.8 Lilacs

For multi-tracked voice, electric guitar, and percussion.

Soundlessly crunch the footsteps
and I know not what to offer your hand
but my own. God is silent at dawn
and soundless in birdsong and the lilacs
offer little to forget.

An empty heart has space for another burden –
share yours.

And as this clumsy mule
trips in another silence,
we shall (at least) balance our load.

Accept my hand and my heart as a humble substitute.

2.3.9 one or two more weeks

For spoken voice.

as I acquired a collection of words that should not be said
i began to store phrases, too.
"one or two more weeks" was the most painful.

soon I will acquire "coffin" and "funeral" and "memorial"
and then there will be no more words.

2.3.10 The Promise

For multi-tracked voice.

Fear not, for I am with you.

When you pass through the water,
I will be with you.
And through the rivers
you shall not be consumed.
And when you walk through fire
you shall not be consumed.

In the passing of a child, or a childhood
God is silent.

In the passing of a child,
I will be with you.

Because you are precious in my eyes,
and I love you.

And I will lay a jasmine blossom
quietly on your headstone.

2.3.11 the transformation

For solo electric guitar.

2.3.12 branches

For processed voice, clarinet, percussion, and electronics.

2.3 Score

1. Guitar Prelude

2. the words that should not be said

(for spoken voice)

safe words are intended to be used
and spoken
or sung.

secret words
should not be spoken
or whispered
or thought
or written.

thirteen months ago
i discovered a new word
"cancer" that I do not speak
or whisper
or write.
it is a noisy word that crowds out other words.

3. White Elephant

Free, flexible (rubato, portamento, and additional vibrato on sustained notes).
Aesthetic is similar to Turkish clarinet improvisation (e.g., klarnet taksim).

You smell of tan-ger-ines and gold silk.

3. White Elephant

Voice: In your hair are tang - led stars - and a white e - le - phant.

Voice: Through my win - dow sev - eral bees are drin - king nec - tar from the red - bud trees.

3. White Elephant

B

Voice — Recit. - very free *mf*

Are __ there red - buds where you are go - ing? ___

B♭ Cl.

Dumbek

mm. 23-27: in the final work, the guitar follows the recitative voice.
Record these chords as individual takes, at approximately double their length.

E.Gtr.

mf

Voice — *mf*

Will __ the land - scape feel _____ like __ home?

B♭ Cl.

Dumbek

E.Gtr.

mf

When you - die___ Shall I take shel - ter be - hind___ your - spine?

In your hair are tang - led stars, and a wound that feels like ___ home

Perc: record mm.24-25 in two takes
Finger Cimbals. Suspend and strike so that they ring.

Another set of **lower finger bells**,
played in the same manner so they ring.

4. Clarinet Interlude

5. secret words

(for spoken voice)

i keep my hands in my pockets to keep the words that should not be said
quietly where they belong
but I may spill them easily

three months ago i discovered "palliative"
and slipped it quietly next to the others.

safe words include "fine" or "tired"
but do not include "gutted"
or "shattered" or "hollow."

for a time
i kept my secret words in my back pockets
until i ran out of space.

in my shirt pocket
quietly rest the extras
close to my heart.

five weeks ago i acquired "hospice," "morphine," and "oxycodone,"
which were shortly joined by "haloperidol," "death" and "dying."

6. Little Tree

Lit-tle tree you are as ill as me, lit-tle tree, Fear not, lit-tle

tree, I will heal you. Lit-tle tree, why do your leaves

curl? Lit-tle tree, fear not, lit-tle tree, fear not,

Voice: I ___ will heal you.

Voice: I ___ will heal you ___

7. cells

(for spoken voice)

"Food" used to be a safe word
but now it is a secret word
as you defend your right not to eat.

i understand that food is punishment
when you are being eaten by cells
that do not belong.

Even "tap water" is a dirty phrase -
all water must sparkle.

8. Lilacs

freely, like plainchant

♩ = 60

Voice 1

Sound - less - ly crunch the foot-steps and I know not what to of - fer your hand but my own.

Electric Guitar

Zills

L.V.

Voice 1

God is sil - ent at dawn ___ and sound - less in bird-song. And the li - lacs of - fer lit - tle to ___ for - get.

Guitar: record each of these three chords individually

E.Gtr.

8. Lilacs

8. Lilacs

B Tempo I (♩ = 60)

Voice 1

And as this clum-sy mule trips in a-no-ther sil-ence, we shall at least light - en our load.

E.Gtr.

C Tempo II (♩ = 120)

Voice 1

Ac - cept my hand and my heart

Voice 2

Ac - cept my hand and my heart

Voice 3

Ac - cept my hand and my heart

E.Gtr.

8. Lilacs

9. one or two weeks

(for spoken voice)

as I acquired a collection of words that should not be said
i began to store phrases.
"one or two more weeks" was the most painful.

soon I will acquire "coffin" and "funeral" and "memorial"
and then there will be no more words.

10. The Promise

Recording Score

Record 4 tracks with a click track, and overtrack them.

Voice 1: Fear not, for I am - with - you.

Voice 2: Fear not, for I am - with you.

Voice 3: Fear not, for I am with you.

Voice 4: Fear not, for I am with you.

Voice 1: When you pass - through - the wa - ter I

Voice 2: When you pass - through the wa - ter I

Voice 3: When you pass - through the wa - ter I

Voice 4: When you pass - through - the wa - ter I

10. The Promise

10. The Promise

not, for I am - with - you.

not, for I am with you.

In the pass-ing of a child or a child - hood.

35

10. The Promise

When you pass - through the wa - ter I will be with you. -

When you pass - through - the wa - ter I will be with you. -

When you pass - through the wa - ter I will - be with

God - is si - lent. Sound - less. __

you. __

10. The Promise

10. The Promise

Fear not, for I am with you.

Fear not, for I am with you.

Fear not, for I am with you.

Fear not, for I am with you.

When you pass - through - the wa - ter I

When you pass - through the wa - ter

When you pass - through the wa - ter

When you pass - through - the wa - ter I

will___ be with___ you. - - - - And

and

and

will be with_____ you._____ and

through the riv - vers you shall not be con-sumed_____ And -

through - the ri - vers you shall not be con-sumed._____

through - the ri - vers you shall not be con-sumed._____

through - the ri - vers you - shall not be con-sumed_____

10. The Promise

through ___ the ri - vers you ___ shall - not be ___

p

and ___ through ___ the ri - vers ___

___ con - sumed.

you ___ shall not be ___ con - sumed

and ___ through _____ the ri - vers You shall not be con -

You shall not be con -

10. The Promise

And - through the ri - vers you shall - not be _____ con-sumed.

you shall - not be _____ con-sumed.

sumed. My _____ home smells like bread and flowers. -

sumed. and through _____ the ri - vers _____

p   *mp*   *pp*

In the pass - ing of a child, I will be with you.

p   *mp*   *pp*

In the pass - ing of a child, I will be with - you.

p   *mp*   *pp*

In the pass - ing of a child, I will be with you.

p   *mp*   *pp*

In the pass - ing of a child, I will be with you.

10. The Promise

Be - cause you are pre-cious in my eyes and I love

Be - cause you are pre-cious in my eyes, and I love

Be - cause you are pre-cious in my eyes, and I love

Be - cause you are pre-cious in my eyes, and I love

you.

you.

you.

you.

11. the transformation

11. the transformation

11. the transformation

12. Branches

(*For processed voice, clarinet, doumbek, paper, wire brush, and electronics*)

"Branches" is an electronic work with no score. The recording is available at https://soundcloud.com/sacurzi/12-branches.

3. Ethical Considerations for the Design and Documentation of Wearable Technologies, Responsive Textiles, and Haptic Sound Art

In this article, I perform close readings of interactive artwork by Joanna Berzowska and XS Labs, Yuri Suzuki, Alyce Santoro, and Anna Biró to demonstrate how these artists disrupt dominant cultural hierarchies (disability, gender, ecology, and globalization). Based on these analyses, I develop a table of ethical considerations for the design and documentation of responsive textiles and haptic sound art. I intend this table to be useful for creators of responsive technologies in art, design, and commercial applications.

While responsive technologies incorporate fields as diverse as science, music, fashion, medicine, art, and textiles, critical discourse on the cultural meaning of wearable electronics and responsive textiles has been limited, with most literature and scholarship focusing on the technological advancements themselves. As a result, creators and consumers of wearable technology engage with increasingly "modern" garments but only rarely interrogate their use.

Infatuation with the "coolness" of these ultra-modern clothes has overwhelmed most of the current publications on wearables, a problem which is documented by two recent scholarly books and one journal article. In the book "Garments of Paradise," Susan Elizabeth Ryan laments the "dearth of

interpretive and critical literature on WT [wearable technology]."[5] Wearable

technology is an extraordinarily broad field (the "makers have backgrounds in

science or technology, fashion, interface design, or art; or they work in teams

representing diverse skills and backgrounds"), but "much of this activity has

gone untouched by historical and cultural examination."[6] An "objectionable

aspect of the literature is its consistently affirmative and advocative tone,

reminiscent of marketing and journalism, and the absence of any negative

remarks, or *any critical perspective whatsoever*"[7] (emphasis added).

Scholar, artist, and curator Camille Baker supports Ryan's concerns,

noting a "lack of critical voices and ethical approaches to making and working

with e-textiles, digital fashion, wearable devices, soft circuits/DIY electronics,

and relative topics, especially as they impact on art, design, research, and

performance."[8] Baker asks, "where are the critical voices in wearable technology

and smart fashion, besides Ryan?"[9]

Elizabeth Wissinger also notes the "largely uncritical guides" to wearable

---

[5] Susan Elizabeth Ryan, Garments of Paradise: Wearable Discourse in the Digital Age (Cambridge: MIT Press, 2014), 6.

[6] Ibid.

[7] Ibid.

[8] Camille Baker, "Critical Interventions in Wearable Tech, Smart Fashion, and Textiles in Art and Performance," in *Digital Bodies,* eds. Susan Broadhurst and Sara Price (Palgrave McMillan, 2017), 178.

[9] Ibid.

technology and references the "lack of qualitative/critical research on the impact of wearable tech." [10] Instead, texts focus on "latest available experiments and prototypes."[11] Like Baker, Wissinger notes Ryan's "unrepentantly critical look at the field of fashionable wearables"[12] as a model for future research. Wissinger notes a higher number of critical voices total (seven studies, including Susan Elizabeth Ryan's monograph) but several of these works, while valuable, are in the domain of sociology – not music and art, which are the focus of my research.

While there is little critical scholarship on wearable technologies, Ryan argues that the role of designers and artists tends to "[position] work as both prototype and commentary, or something in between," and sometimes inhabit a "third, 'critical' space of WT [wearable technology]."[13] However, "[internet] publicity for the garment absorbs the larger critique,"[14] creating a particular challenge for artists and designers who wish to emphasize politics or cultural meaning.

My work aims to help rectify the problems that Ryan, Wissinger, and Baker have described in current academic literature. To begin, I demonstrate the

---

[10] Elizabeth Wissinger, "Wearable Tech, Bodies, and Gender," *Sociology Compass* 11, no. 11 (2017): 3.
[11] Ibid.
[12] Ibid.
[13] Susan Elizabeth Ryan, *Garments of Paradise: Wearable Discourse in the Digital Age* (Cambridge: MIT Press, 2014), 7.
[14] Ibid.

ways in which four artists have disrupted dominant power dynamics of gender,

ecology, disability access, and global inequality. Next, I argue that existing

artwork can inform the ethical decisions involved in the creation, transmission,

documentation, and advertisement of responsive technologies. Interactive art can

serve as an ethical model for anyone working with responsive technology.

My research culminates in a set of ethical considerations for the design

and documentation of responsive textiles and haptic sound art. These ethical

considerations are presented in a table for easy reference. I hope that my work

will support artists, designers, scientists, and businesspeople in the early stages

of creating their intended artwork or commercial product, and that it may also

inform their practical choices about sourcing physical material. I also hope my

research will affect decision-making regarding photographic styles for the

purposes of advertising or (in the case of artists) public documentation, which

currently promotes thin, white, cisgender women.

My work also has tangible benefits for commercial applications. Ethical

materials sourcing and labor can protect companies from expensive lawsuits and

loss of income from damaged brand image. If companies voluntarily choose to

adopt improved safety measures, it can also help prevent consumer boycotts and

government embargos (such as the United States suspension of trade with

Bangladesh, "largely in response to the Rana Plaza collapse."[15]

3.1 Joanna Berzowska and XS LABS: Responsive Clothing That Resists Sexual Violence

Artist and designer Joanna Berzowska[16] is the "founder and research

director of XS Labs, where her team develops innovative methods and

applications in electronic textiles and responsive garments."[17] As Berzowska

states in the XS Labs catalogue,

> Our approach often engages subtle elements of the absurd, the perverse, and the transgressive. We construct narratives that involve dark humor and romanticism as a way to drive design innovation. These integrative approaches allow us to construct composite textiles with complex functionality and sophisticated behaviors.[18]

Several works such as *Reclaim* and *Distract* are cut to fit a female body and

contain design features that partially protect the wearer from unwanted touch.

More conceptual rather than practical, these works reflect a desire for self-defense and personal space.

Distract is a dress that contains inflatable silicone compartments "reminiscent of breasts."[19]

Figure 1: *Distract* – An Inflatable Dress by Joanna Berzowska and XS Labs.

---

[19] Joanna Berzowska and XS Labs, "Distract Dress", http://www.xslabs.net/work-pages/distract.html, accessed November 6th, 2019.

The XS Labs catalogue states:

> Influenced by animals such as puffer fish that can rapidly increase their size by pumping water or air into special sacs, DISTRACT contains a network of interconnected inflatable silicone compartments. In situations where the user feels threatened and requires immediate action, she can mouth-inflate protrusions around the body to intimidate and confuse the enemy.[20]

The documentation for *Distract* references self-defense but does not explicitly identify the type of danger. We know that the dress is meant to be deployed in "situations where the user feels threatened," and we know that the self-defense mechanism is meant to be time sensitive (when the user "requires immediate action"). The language of threat, danger, and self-defense In XS Lab's documentation implies that *Distract* is meant to be used as a weapon; the gendered pronoun in the documentation ("she") suggests that the dress is designed to protect a female-identifying person. But what is the nature of the weapon, against whom is it meant to be used, and in what situations? And who is the "enemy"? To better understand the meaning of this dress, I perform a close reading of the information released by Berzowska and her team on the XS Labs website and catalogue.

One way to read *Distract* is in terms of deimatic display, a self-defense behavior used in the animal kingdom. 'Deimatic' "is generally used to describe

---

[20] Joanna Berzowska and XS Labs, "Seven Years of Design Research and Experimentation in Electronic Textiles and Reactive Garments," (2010) 27. http://xslabs.net/catalogue-pdf/XS_catalogue.pdf.

behavior in which, when under attack, prey suddenly unleash unexpected defenses to frighten their predators and stop the attack."[21] "Traditionally, deimatic displays are expected to pre-emptively confuse or shock the predator, making it pause in its attack long enough for prey to escape."[22] This description is consistent with the title *Distract* and also with the documentation, which suggests that the inflatable compartments are meant to "intimidate and confuse the enemy" "in situations where the user feels threatened and requires immediate action."[23] In this reading, the changing shape of the dress is meant to shock the "enemy," giving the wearer a few extra moments to escape.[24] Given that the documentation explicitly refers to a female wearer ("she") and that the dress is cut with bodice darts[25] that fit a stereotypically female figure but not a

---

[21] Kate D.L. Umbers. "Deimatic Displays," *Current Biology* 25, no 2 (2015): R58-R59.

[22] Ibid.

[23] Joanna Berzowska and XS Labs, "Seven Years of Design Research and Experimentation in Electronic Textiles and Reactive Garments," (2010) 27, http://xslabs.net/catalogue-pdf/XS_catalogue.pdf.

[24] Deimatic display can refer to visual or auditory surprise mechanisms. While "Distract" and "Reclaim" make a small amount of noise while inflated, it not likely to be very loud, especially in crowded urban environments such as subway trains (mentioned in catalogue documentation for "Reclaim"). Given that neither XS Labs or Berzowska have referred to the sound of Reclaim and Distract being inflated, and given that the sound not likely to be loud, sound is not a core component of these works' meaning. However, sonic notions of deimatic display are used in other artistic works such as Suzi Webster's *Barking Mad* (2005-2006), a sonic jacket discussed later in this article. To my knowledge, existing garments tend to interpret deimatic display only in the conceptual sense, but I would be interested in a garment that actually contained surprise defense mechanisms, especially one that could be specially designed for the needs of women, transgender people, non-binary people, and other populations exposed to much higher than average levels of interpersonal violence.

[25] A bodice is the tight upper portion of a dress that covers the chest and back. Darts are triangular shaped folds that are sewed into a garment in order to make flat fabric fit the human figure. They are particularly common at the bust, waist, and hips of garments for women. In this passage, I argue that the fabric is shaped in such a way that it will not fit a cisgender male without significant modification.

male one, we might interpret this dress as a distraction technique that allows a

female-identifying person to defend herself from gender violence.

The mechanism of defense – surprise, shock, or distraction – is an active

one. While many responsive garments feature automatic mechanisms, the wearer

of *Distract* possesses full agency over the choice to inflate. Notably, *Distract* does

not reproduce the common problem noted by Susan Elizabeth Ryan, who

suggests that when a person wears technology, "the agency of the subject who

wears the technology is repressed or rendered invisible."[26] Instead, *Distract* can

be read as a garment-mediated enhancement of behavioral options for female-

identifying people. My analysis overlaps with Jake Moore's remarks in the XS

Labs catalogue. Moore notes that "wearers of XS garments are aware of their

roles and are *active participants* in them, bringing into question the simplistic

notion of fashion victim" (emphasis added).[27]

Scientific documentation of deimatic display – surely accessible for a

Massachusetts Institute of Technology graduate such as Berzowska – suggests

that deimatic display provides an active alternative to camouflage, a passive

defense technique. As stated in *Current Biology*, "we expect that deimatic displays

---

[26] Susan Elizabeth Ryan, *Garments of Paradise: Wearable Discourse in the Digital Age* (Cambridge: MIT Press, 2014), 13.

[27] Joanna Berzowska and XS Labs, "Seven Years of Design Research and Experimentation in Electronic Textiles and Reactive Garments," (2010) 27. http://xslabs.net/catalogue-pdf/XS_catalogue.pdf

involve co-evolutionary processes, as they are exposed to selection only when prey primary defences (e.g. camouflage) fail."[28] In other words, species have evolved to use deimatic display because sometimes primary defense mechanisms (such as "camouflage") fail – this evolution points to the fact that deimatic display is in fact a life-or-death behavior. In a gendered reading of *Distract*, the inflation of the silicone compartments can be read as an agential response to gender violence; the woman wearing this dress can choose to "distract" instead of "camouflage."[29]

This reading also sharply divides the onlooker and the wearer into predator and prey, a reading that shifts the work from being read in terms of gaze theory and moves it to a realm that is explicitly physical. *Distract* is not just about being looked at – it is about safety and enhanced bodily control.

The location of the inflatable compartments – the physical sites of garment-enhanced self-defense - can also be read in terms of gendered violence. In the photo of *Distract*, the compartments are clustered over the wearer's breasts, abdomen, hips and thighs, with the largest compartments on some of the most vulnerable parts of the body: the abdomen and pelvis. As feminist scholar

---

[28] Umbers, Kate D.L. "Deimatic Displays," *Current Biology* 25, no 2 (2015): R58-R59.
[29] Ibid.

Naomi Wolf writes in her seminal and controversial best-seller, *The Beauty Myth:*

How Images of Beauty Are Used Against Women:

> Breasts, thighs, buttocks, bellies; the most sexually central parts of women, whose "ugliness" therefore becomes an obsession. Those are the parts most often battered by abusive men. The parts that sex murderers most often mutilate. The parts most often defiled by violent pornography. The parts that beauty surgeons most often cut open. The parts that bear and nurse children and feel sexual. A misogynist culture has succeeded in making women hate what misogynists hate.[30]

The self-defense compartments of *Distract* strongly correlate with the parts

of the female body most vulnerable to sexual violence. It is reasonable to read

Distract as a garment meant to defend against unwanted touch, because the

woman wearing it will have a physical buffer (a compartment filled with air)

preventing another person from touching her body directly in a few specific

areas. The compartments do not protect against touch on all areas of the body,

but by protecting some parts of the body, the compartments do offer a woman

increased protection compared to a "normal," non-responsive, gender-

conforming dress.

Distract's real-life self-defense capability is limited to protecting against

unwanted touch, and only in a few areas of the body that are covered by the

inflatable compartments. It cannot protect against assault, rape, murder, or

---

[30] Naomi Wolf, *The Beauty Myth: How Images of Beauty Are Used Against Women* (New York: HarperCollins, 2002), 150.

battery, and is therefore limited in its response to realistic defense needs. In addition to providing a few limited self-defense capabilities, *Distract* might be read as a fantasy of potent and deadly self-protection from sexual violence.

In *Distract's* documentation in the XS Labs catalogue, the inflatable compartments over the breasts, abdomen, and thighs are related to the pufferfish, which contains deadly paralytic poison. This poison is not physically built into *Distract*, but it is inscribed in the dress's meaning. When we combine the XS Labs documentation, the physical construction of the dress, and Naomi Wolf's comment on the historic and current nature of sexual violence, the reference to pufferfish suggests a desire for a deadly weapon to defend the female body from unwanted touch. Women can't poison men with their bodies, but *Distract* hints at a desire for a garment that can. What if women could easily kill sexual perpetrators, the dress seems to ask? How might that affect our freedom, safety, and expectations of safety?

The specific nature of pufferfish poison might also contribute to an understanding *Distract*. Pufferfish venom, tetrodotoxin,[31] paralyzes muscles and leads to respiratory failure and death. The fact that pufferfish poison kills

---

[31] Tamao Noguchi, Kazue Onuki, and Osamu Arakawa, "Tetrodotoxin Poisoning Due to Pufferfish and Gastropods, and Their Intoxication Mechanism," *ISRN Toxicology* (2011), doi: 10.5402/2011/276939. See also "Advisory on Pufferfish," FDA.gov, U.S Food and Drug Administration, updated January 17, 2014, https://www.fda.gov/food/alerts-advisories-safety-information/advisory-puffer-fish.

through muscle paralysis enhances my reading. Arguably, male muscle strength is a physiological feature that allows for sexual violence and partially explains the fact that it so disproportionately affects women: the average male has stronger muscle than the average female. The fact that *Distract* reflects a desire for paralytic poison that directly affects muscles may also reflect a desire to reverse this physiological power imbalance, providing women with a deadly weapon that can reverse the abilities of male muscle. If a dress meant for women really contained pufferfish poison, we wouldn't have to worry about going out alone at night or experiencing domestic violence. *Distract* hints at a powerful fantasy of self-protection from gendered violence.

Berzowska's and XS Labs' *Reclaim*, another piece in "The Inflatable Series," shares overlapping functionality with *Distract*, and uses inflatable compartments to create additional personal space.

> RECLAIM features two large silicone balloons placed on either hip, which can be inflated with a portable bottle of compressed air in order to increase the amount of personal space occupied by the user. In a crowded subway car or in any other situation where more privacy is required, the dress can be inflated to create a physical buffer between the user and the public sphere.[32]

---

[32] Joanna Berzowska and XS Labs, "Seven Years of Design Research and Experimentation in Electronic Textiles and Reactive Garments," (2010) 24. http://xslabs.net/catalogue-pdf/XS_catalogue.pdf

Figure 2: *Reclaim* **– An Inflatable Dress by Joanna Berzowska and XS Labs.**

Reclaim can be read in a similar way as *Distract*: the inflatable mechanism

is a way to protect against unwanted touch, especially because the bodice is

shaped for a female body and because the protective mechanism is at the hip, a

site I have already shown is more often subject to gendered attack. In this reading, the title *Reclaim* might refer to the act of reclaiming one's own body.

On the other hand, the documentation in XS Labs catalogue refers to a need for "privacy" and "a physical buffer" in specific situations such as a crowded subway car. A crowded subway car is a physical and social context where unwanted groping can and does occur, but the documentation does not preclude other readings. *Reclaim* could also refer to the act of reclaiming personal space in crowded, urban environments. If the dress were worn and inflated in situations such as a crowded subway, the inflatable compartments would require other people to stand a little further away. *Reclaim* can therefore be read as a feminist garment or as a garment that resists the effect of urban crowding on personal space.

While designers have created several responsive garments that protect against the elements,[33] a design approach consistent with historical textile use, both *Reclaim* and *Distract* suggest that responsive garments can also protect

---

[33] For example, see the work of Italian company Grado Zero Espace, who created *K-Cap*, a responsive temperature-sensing balaclava "to be used during a scientific expedition on Mount Everest." Sabine Seymour, *Fashionable Technology: The Intersection of Fashion, Science, and Technology* (Austria: Springer-Wien, 2009), 186. See also WarmX, a German company that has developed electronically powered wireless technology to create heated garments "which make it possible for users to feel well and to move freely at low temperatures." Ibid., 192.

people from other people: they can provide defense against unwanted touch or urban crowding. Artist and designer Teresa Almeida takes a similar approach with her *Modes for Urban Moods* (2005), "a suite of wearable coping mechanisms."[34] *Space Dress*, one of the garments in this series, "inflates on the wearer's command and is designed to cope with stress, anxiety and claustrophobic situations or simply to provide additional comfort. It was originally designed for rush hour use on the NYC subway system."[35] This approach overlaps with artist Suzi Webster's *Barking Mad* (2005-2006), a coat which was "designed to help shy, stressed people deal with situations of urban overcrowding. Proximity sensors respond to infringements on personal space by emitting the sound of a barking dog through flat panel micro speakers."[36]

Younghui Kim, designer and Chief Creative Officer at Missing Pixel in New York City, adopted an alternative approach to urban crowding: one that celebrates it. Kim's *Stir-It-On* is an "interactive wearable skirt" whose "subtle," "beautiful," and "fashionable" reactive lights respond to gentle touch. *Stir-It-On* is intended for "crowded urban cities" where "many people pass near you or

---

[34] Sabine Seymour, *Fashionable Technology: The Intersection of Fashion, Science, and Technology* (Austria: Springer-Wien, 2009), 153.
[35] Ibid.
[36] Ibid., 63.

even touch you with their coats, jackets, or bags."[37]

In *Distract* and *Reclaim*, the theme of protection from people and urban

crowding reflects the design approach of the XS Labs team, who write:

> The focus on health monitoring and surveillance technologies clearly reflects the
> (military and pharmaceutical) funding structures and fails to deliver appealing
> product ideas that respond to personal, social and cultural needs.[38]

Reclaim and *Distract* also subtly remind designers who are interested in

"personal, social and cultural needs" that these needs are flexible and depend

both on demographics of the wearer and on the wearer's subjective experience.

These dresses can fit cisgender women, some transgender women, and some

non-binary people, but cannot fit cisgender men due to the bust darts and waist

shaping. As we design new responsive garments, Joanna Berzowska and XS Labs

remind us of several questions.

"As designers of wearable technologies," they write, "we need to step

back and ask why we want our garments to be electronic. What kind of

information processing do we want to carry out on our bodies? What kind of

functionality do we want to enable inside our clothes?"[39] For whose bodies are

we designing?

---

[37] Ibid., 129.

[38] Joanna Berzowska and XS Labs, "Intimate Technology," XSLabs.net, http://www.xslabs.net/theory.html.

[39] Joanna Berzowska and XS Labs, "Intimate Technology," XSLabs.net, http://www.xslabs.net/theory.html.

3.2 Yuri Suzuki: *Looks Like Music*

Yuri Suzuki is an internationally award-winning "sound artist, designer, and electronic musician"[40] whose works are part of the collections at the Museum of Modern Art (New York), The Art Institute of Chicago, The Israel Museum (Jerusalem), the London Transport Museum, the Nam Jun Paik Art Center (Seoul), and the Église Saint-Pierre (Firminy, France).[41] Suzuki and his London-based Yuri Suzuki Design Studio work with an international client base "who are looking to push the boundaries of design, technology, and sound."[42] Suzuki's work "looks into the relationship between sound and people, and how music and sound affect their minds."[43]

This attitude is reflected in the design and documentation for *Furniture Music*, a set of "two main bodies of work"[44] that includes an immersive installation called *Sound of the Waves* (2018) and "a series of appliances and furniture pieces conceived for the kitchen/living areas of the home which include, amongst others, a Singing Washing Machine (2018), developed in conversation with composer Matthew Herbert, and a Musical Kettle

---

[40] Yuri Suzuki, "About," YuriSuzuki.com, http://yurisuzuki.com/about.
[41] Ibid.
[42] Ibid.
[43] Ibid.
[44] Ibid.

(2017)."[45] In the video documentation for *Furniture Music*, Suzuki states, "sound

has a strong effect on people. It can give us comfort and a lot of other positive

effects. Meanwhile, if it is designed badly, it can also give us discomfort, and

distract us from enjoying life."[46] Suzuki's approach overlaps with user-centered

design (UCD) because it is focused on the needs of the user, but it is not clear

whether Suzuki adopts UCD's iterative design process, which normally changes

based on user feedback. Suzuki might design for an imagined user.

Suzuki's comments suggest that design can affect how we feel; he places

value on design that creates "comfort" and "positive effects." If bad design

causes "discomfort" and "[distracts] us from enjoying life," ostensibly, good

design is meant to make us feel better. Based on Suzuki's comments, we almost

suspect that good design is functional medicine.

Suzuki also explains that "Furniture Music attempts to re-design the

domestic soundscape and propose ways for sound to not turn into noise but

rather help enhance harmony and comfort within one's surrounding

environment,"[47] a comment that resists the values of the traditional concert hall

in several ways. First, concert hall music is sometimes meant to make us feel sad

---

[45] Ibid.

[46] Yuri Suzuki "Furniture Music," YuriSuzuki.com, http://yurisuzuki.com/artist/furnituremusic.

[47] Yuri Suzuki "Furniture Music," YuriSuzuki.com, http://yurisuzuki.com/artist/furnituremusic.

or uncomfortable (perhaps with the idea this vicarious suffering might cause much-needed catharsis – or not). Alban Berg's *Lulu* is an obvious and canonized example; most listeners will not find Lulu's sex work to be comforting, nor will they feel particularly soothed by Jack the Ripper's murder of two women (nor his complaints, after stabbing them, that the room lacks a towel). Suzuki's *Furniture Music* enhances "harmony and comfort" – its purpose is like that of a warm blanket.

Unlike "classical" concert hall music, *Furniture Music* is meant for a domestic environment. In the photographs on Suzuki's website[48], the singing kettle and musical washing machine appear in a staged domestic environment in the Stanley Picker Gallery (Kingston, England); the "dishwasher" and "cabinets" appear to be painted with bold black lines. It is clear, however, that Suzuki's singing kettle and musical washing machine could easily be used in one's home, especially if they were made commercially available. Whether or not the works eventually appear in real homes, *Furniture Music* suggests that domestic spaces are a valid site for expressive objects, an attitude that perhaps recalls the early twentieth century aesthetics of Bauhaus movement, which allowed for the fusion of fine art, functional objects, and design.

---

[48] Yuri Suzuki "Furniture Music," YuriSuzuki.com, http://yurisuzuki.com/artist/furnituremusic.

Suzuki's work also reminds us that art intended for domestic spaces can sometimes be more accessible to people with disabilities. For people who cannot attend traditional concert halls due to disability (for example, due to pain, mobility problems, sensory issues around noise, light, and people, psychological intolerance of crowds or open spaces, etc.), art objects for home use have the potential to make art more accessible. In this initial presentation of *Furniture Music*, a person would still need to be healthy enough to attend the gallery opening, would need access to transportation to the gallery, and would need to be able to afford transportation, time off work (if employed), and the gallery entrance fee. Despite the privilege hurdles inherent in the first presentation of *Furniture Music*, this work suggests that art designed for home use might be made accessible, at least hypothetically, for those who cannot physically or emotionally tolerate travel to a concert hall or the sensory environment of classical music concerts.

The need for accessible art is reflected in recent concerts by groups such as the North Carolina Symphony, which hosted its first "sensory-friendly" concert on Saturday, Sept. 14, 2019, in the Duke Energy Center for Performing Arts in

downtown Raleigh.[49] As noted on local news website, WRAL.com:

> [The North Carolina Symphony] joins Raleigh Little Theatre, NC Theater, the PNC Arena, Theatre in the Park, the Museum of Life and Science, the NC Museum of Natural Sciences, Marbles Kids Museum, and the Durham Performing Arts Center, among others, in offering special performances and events designed for those who have trouble with loud noises, bright lights or crowds because of sensory sensitivities, which are common in those with autism.[50]

The concerts also provided accommodations for those with disabilities, including:

- Providing a designated quiet space available throughout the concert.
- Creating a social story that prepares audiences for the concert experience, which will be provided ahead of concert day.
- Setting the lights at a lower level throughout the performance.
- Ensuring accessible accommodations, including wheelchair seating, ASL interpretation, Braille and large-print programs.[51]

The accommodations in these concerts suggest that the typical concert hall performance is not accessible to all people who might wish to attend a concert. The use of a "designated quiet space" at the North Carolina Symphony creates a safe space for those who are interested in hearing music, but cannot tolerate the sounds of a concert for the length of time that is expected of classical music audiences, who are normally expected to sit still and listen from the beginning of

---

[49] Sarah Lindenfeld Hall (web editor), "NC Symphony's first sensory-friendly concert is this weekend," WRAL.com, Capitol Broadcasting Company, September 10, 2019, https://www.wral.com/nc-symphony-s-first-sensory-friendly-concert-is-this-weekend/18559967/.
[50] Ibid.
[51] Ibid.

the concert or opera until intermission, and from intermission until the

performance ends. When people move around, cough, make noise, stand, or exit

a concert hall while music is playing, they are considered disruptive or rude. The

social pressure to be quiet and still disproportionately affects people who may

not be able to tolerate noise, sound, crowds, extended periods of sitting still

(some of these symptoms are common in diverse conditions such as attention

deficit disorder, autism, sensory processing disorder, migraine, chronic pain,

panic disorder, post-traumatic stress disorder, and other conditions). The social

rules in the concert hall are also likely to be harder to tolerate for children,

especially children with health problems, because impulse control develops over

time as people age.

If we compare the accessibility of the standard concert hall experience to

galleries, museums, and outdoor spaces where Yuri Suzuki's works are usually

presented, we can see that there are several important accessibility differences. In

a gallery or museum, a person can leave an installation if the environment

becomes intolerable due to a health condition. And if a person does need to leave

a gallery or museum installation, that person is not considered irritating or

disruptive, because the social expectations around installations are that people

can leave whenever they wish. It is possible to read museums and gallery spaces

as more welcoming to people with sensory disabilities because people can leave

70

if they need to (these environments, of course, are less hospitable to people who cannot remain standing easily). Suzuki's *Furniture Music* can be seen as more accessible to people who cannot tolerate a concert hall environment.

Gallery and museum installations, as well as outdoor installations, are also more welcoming to people who cannot sit still easily. In Suzuki's *Garden of Russolo,*[52] visitors can have a "sonic experience using their own voice." Documentation of this work suggests that it is highly interactive and welcoming even to small children, who can be seen putting their heads in the artwork, making sounds with their voice, and smiling when they hear their own voice sonically processed. The photographs on Suzuki's website suggest that the work can be installed indoors, as it was at the London's Victoria and Albert Museum, or outdoors.

Garden of Russolo is based on Suzuki's earlier work, *White Noise Machine*, which was part of the sound installation *Silent City* in New Delhi, India. *White Noise Machine* "can calculate the quantity of street noise, and then generate the same amount of white noise." [53] Both *Garden of Russolo* and *White Noise Machine*

---

[52] Yuri Suzuki, "Garden of Russolo," YuriSuzuki.com, http://www.yurisuzuki.com/artist/garden-of-russolo.
[53] Yuri Suzuki, "White Noise Machine," YuriSuzuki.com, http://yurisuzuki.com/archive/works/white-noise-machine/.

are inspired by Italian Futurist[54] composer and painter, Luigi Russolo, who

invented noise machines called *intonarumori* between 1913 and 1921 with his

assistant Ugo Piatti.[55] These *intonarumori* were "mostly based on the principle of

the Hurdy-gurdy; the instrument was housed in a brightly painted box and the

performer turned a crank or pressed an electric button at the rear to operate it;

pitch was controlled by a lever on the top."[56] The noisy growling of these

intonarumori reflected Russolo's belief that "we must break at all cost from this

restrictive circle of pure sounds and conquer the infinite variety of noise-

sounds."[57]

The visual similarity between Russolo's *intonarumori* and Suzuki's *Garden*

of Russolo and *White Noise Machine* is striking. While Suzuki based *Garden of*

Russolo and *White Noise Machine* on the appearance and sonic aesthetic of

---

[54] Futurism was "artistic movement founded in 1909" that was "initially Italian" but "soon adopted by the Russian avant garde." This movement reflected an "obsession with speed, machines and industry," and promoted the use of noise and industrial sounds as musical material. Scholars Dennis and Powell note that Futurism had a "broad and inestimable" effect on 20th century music, and directly parallels John Cage's ideas as well as those of *musique concrète* composers. See Flora Dennis and Jonathan Powell, "Futurism," *Grove Music Online*, 2001, https://doi org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.10420. Russolo's interest in noise was also consistent with early Modernism, a movement that involved departure from 19th century musical conventions, particularly the "concept and practice of tonality, the reliance on recognizable rhythmic regularities, the dependence on traditional instruments and sonic effects and the use of extended compositional forms." See Leon Botstein, "Modernism," *Grove Music Online,* 2001, https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.40625.
[55] Flora Dennis, "Luigi Russolo," *Grove Music Online*, 2001, https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.24174.
[56] Ibid.
[57] Luigi Russolo, *The Art of Noise*, trans. Robert Filliou (Ubu.com: Ubu Classics, 2004), 7, http://www.artype.de/Sammlung/pdf/russolo_noise.pdf. Originally published in 1967.

Russolo's *intonarumori*, Suzuki's versions also record the listener-participants'

voices, process them, and play them back, a feat possible with modern

technology. This alters the role of the listener, who becomes a crucial part of the

performance of sound. While reconstructions[58] of the Russolo's *intonarumori*

show adults and children watching the sound being created, Suzuki's versions

succeed in inviting listeners to become active participants.

Figure 3: Luigi Russolo's *intonarumori, 1913*

[58] "Luigi Russolo, Intonarumoris, 1913," Youtube.com, Jul 1, 2012,
https://www.youtube.com/watch?v=BYPXAo1cOA4. Russolo's *intonarumori* were destroyed during World
War II, but several reconstructions have been made. In this video, pay attention to the behavior of the
adults and children observing the *intonarumori*, and the way these instruments create a clear behavioral
divide between the woman demonstrating the instruments and the people watching. Compare the
onlookers' behavior in this *intonarumori* video to that of museum visitors interacting with Suzuki's *Garden
of Russolo*. Yuri Suzuki, "Garden of Russolo," YuriSuzuki.com, http://www.yurisuzuki.com/artist/garden-
of-russolo.

Suzuki's *Garden of Russolo* allows the visitor a degree of control over their

sensory experience in a way that traditional concert halls do not. When a person

puts their head in the "phonograph-like wooden [box]," they can make sound, or

not, and if the tight space or sound of their voice echoing becomes intolerable,

they can pull their head out and stop speaking. The processed sound can also be

played back by turning the crank, which allows listeners additional agency over

their experience of the work.

Figure 4: Yuri Suzuki's *Garden of Russolo*

Themes of accessibility also appear in Suzuki's *Looks Like Music*, an

interactive musical work intended for paper, markers, small robots, and

audience/visitor participation.

74

[Looks like Music] consists of a miniature robot which detects and follows a circuit – a black line traced in marker pen – interspersed with coloured reference points that the device translates in sound. The public is invited to actively contribute to the development of the installation in the exhibition space by extending the circuit drawn on paper. Visitors thus participate in the creation of a large-scale artwork and enrich a collectively composed sound piece.[59]

Figure 5: Children Interacting with Yuri Suzuki's *Looks Like Music*

According to Dezeen, an architecture and design magazine that has won

numerous awards for journalism and publishing,[60] and whose writers

interviewed Suzuki, "Looks like Music is a development of Suzuki's "earlier

---

[59] Yuri Suzuki, "Looks Like Music," YuriSuzuki.com, http://yurisuzuki.com/artist/looks-like-music.
[60] "About Dezeen," Dezeen.com, https://www.dezeen.com/about/.

project focussing on dyslexia,"[61] *Colour Chaser*.

> A miniature vehicle that detects and follows a black line whilst it reads crossing coloured lines and translates this RGB data into sound. Users could draw a randomly shaped circuit using a black marker pen on a piece of paper and the colour chaser followed the line. then add different layers of colour across the black line at intervals the vehicle detects the colour RGB data and translates that into sound.[62]

Figure 6: Yuri Suzuki's *Colour Chaser*

Suzuki told Dezeen, "I am dyslexic and I cannot read musical scores.

However, I have a passion to play and create new music and I always dream to

[61] Kate Andrews, "Looks Like Music by Yuri Suzuki," Dezeen.com, September 15, 2013, https://www.dezeen.com/2013/09/15/looks-like-music-by-yuri-suzuki/.

[62] Yuri Suzuki, "Colour Chaser," YuriSuzuki.com, http://yurisuzuki.com/archive/works/colour-chaser/.

create new notation of music."[63] Suzuki's comments suggest that playing classical

music in the European tradition is often inaccessible to many people with visual

disabilities. While a person can be taught to play by ear, it is slow, and excludes

musicians with visual disabilities from professional positions that involve sight-

reading (which currently covers most performance opportunities in classical

music, whether it's playing in a classical orchestra, chamber ensemble, or hourly

paid positions known as "gigs" among working musicians). Suzuki's comments

also raise an important question. If music is meant to be heard, why is it so

critical to be physically able to see it?

There is a historical reason for the powerful position of written music in

the European classical tradition. According to the respected online music

database, *Oxford Music Online*, "the reigns of the Frankish kings Pippin the Short

(751–68) and Charlemagne (768–814) are thought to be the most likely period

when a pressing need for plainchant notation could first have arisen."[64]

Additionally, "the Franks made strenuous efforts to remodel their liturgical

practices along Roman lines and, during the reign of Charlemagne, initiated a

---

[63] Kate Andrews, "Looks Like Music by Yuri Suzuki," Dezeen.com, September 15, 2013, https://www.dezeen.com/2013/09/15/looks-like-music-by-yuri-suzuki/.

[64] Ian D. Bent, David W. Hughes, Robert C. Provine, Richard Rastall, Anne Kilmer, David Hiley, Janka Szendrei, Thomas B. Payne, Margaret Bent and Geoffrey Chew, "Notation," *Oxford Music Online*, revised 2014, https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.20114.

wide-ranging programme of educational reform, which might have included music writing."[65] This "remodel" would have suppressed local Gallic melodies[66] and methods of worship in favor of a standardized version adhering to the melodies and text used in the Vatican. *The Oxford History of Western Music* also cites political motivations for the use of notation. The authors state that "the alliance of imperial and papal authority led to a short period of peaceful stability during which there was a resurgence of learning and creativity known as the Carolingian Renaissance."[67] Music during this time was "singled out for preservation in written form,"[68] and "there was a need for notation because of the aim of the powers in Rome to spread its liturgy and music elsewhere."[69] *A History of Western Music* cites a similar story, adding that "notation was both a result of striving for uniformity and a means of perpetuating that uniformity."[70]

Today, a deep understanding of modern notation is a requirement for any professional classical music performer (notation is significantly less important

---

[65] Ian D. Bent, David W. Hughes, Robert C. Provine, Richard Rastall, Anne Kilmer, David Hiley, Janka Szendrei, Thomas B. Payne, Margaret Bent and Geoffrey Chew, "Notation," Oxford Music Online, revised 2014, https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.20114.

[66] Richard Taruskin and Christopher H. Gibbs, *Oxford History of Western Music* (New York : Oxford University Press, 2013), 8.

[67] Ibid.

[68] Ibid.

[69] Ibid.

[70] Peter Burkholder, Donald J. Grout, and Claude V. Palisca, *A History of Western Music* (Canada: WW. Norton and Company, 2019), 29.

and sometimes irrelevant when musicians seek opportunities in other musical styles such as jazz or contemporary improvisation). The problem with notation-heavy classical music opportunities is that they exclude talented performers who are blind, dyslexic, or who have other disabilities that interfere with reading a musical score.[71]

I do not wish to imply that there are no classical music performers with visual impairments. However, most classical music opportunities in the present day require sight-reading due to extreme time constraints created by funding limitations. Players are often expected to play through music briefly before a concert, or even to sight-read during gigs. This kind of time limitation does not allow time for musicians to have an assistant pass on the music, as was done historically. Additionally, assistive software does not account for the needs of all visual disabilities such as dyslexia. These factors create barriers that are likely to pressure performers with visual disabilities into musical fields such as jazz and blues, where reading music is not a professional requirement, or to choose fields such as music composition, where the need to read scores instantly can sometimes be overcome with technology.[72]

_____

[72] A detailed discussion of the use of assistive technology is beyond the scope of this article. For a more detailed introduction to assistive technology in music, see Kevin Gibb's excellent article. The needs of specific musicians will vary, so his comments cannot be generalized to every artist, but it is a useful

Suzuki cleverly addresses this problem in *Colour Chaser* and *Looks like Music,* in which the art installation is remarkably similar to an avant-garde, responsive music score. Not only is the score accessible to those with visual disabilities, it is accessible to people with no training at all. Even small children can draw colored lines on paper and watch (and listen) as the little robots respond to the colored lines. Suzuki hasn't solved the problem of accessibility in classical music, but his work suggests that music opportunities can be made more accessible in the future.

As I have shown, classical music has a history of excluding certain people from performing professionally or listening to music in a concert hall. Even though previous music has often required performers and audience members to adjust to written music and concert hall spaces, at the exclusion of some people with disabilities, Suzuki's work suggests that responsive technology can allow art and music to cater to audiences, participants, and musicians, while blurring the roles between these social categories.

---

introduction for readers who are not familiar with the creative and professional barriers created by disability. Kevin Gibbs, "Insights on Blindness and Composing," *New Music USA,* https://nmbx.newmusicusa.org/insights-on-blindness-and-composing/.

3.3 Alyce Santoro: Weaving Music Industry E-Waste into Responsive "Sonic Fabric"

Alyce Santoro resists traditional artist categories. The biography on her website describes her as "an intermedia conceptual/sound artist with a background in biology and scientific illustration."[73] On her homepage, she identifies as "social surrealist, delicate empiricist, rhythmanalyst, [and] philosoprovocateur."[74] Her "visual and sound pieces have appeared in over 50 exhibitions internationally related to innovative textiles; experimental musical scores; sound and listening; and social action and ecology" and "her written works have appeared in Leonardo Music Journal, the Center for Sustainable Practice in the Arts Journal, Antennae, Waging Nonviolence, and Truth-out."[75]

Santoro is also the inventor of Sonic Fabric, an "an ongoing work of sound/conceptual art" in which "editions of an audible textile are woven from recycled audiocassette tape" and playable with an altered Sony Walkman or a tape head glove.[76] The tape itself "has been recorded with collages of collected,

---

[73] Alyce Santoro, "Information," AlyceSantoro.com, http://www.alycesantoro.com/information.html
[74] Alyce Santoro, AlyceSantoro.com, http://www.alycesantoro.com/.
[75] Alyce Santoro, "Information," AlyceSantoro.com, http://www.alycesantoro.com/information.html.
[76] Alyce Santoro, "Sonic Fabric," AlyceSantoro.com, http://alycesantoro.com/sonic_fabric.html.

created, and found samples of sound and music."[77]

Figure 7: Dress woven from audiocassette tape, by Alyce Santoro

---

[77] Ibid. Composer and performance artist Laurie Anderson invented an important precursor to Santoro's Sonic Fabric: the tape bow violin. Anderson altered a regular violin, replacing the horsehair in the bow with audio tape, and using a tape head as the instrument's bridge (normally made from wood). The magnetic tape in the altered violin bow has audio recorded onto it, which can be played backwards and forwards at different speeds. Like Santoro, who uses sampled sound on audiocassette tape for her Sonic Fabric, Anderson defamiliarizes the original sound source recorded onto the tape. Also notable is composer and visual artist Christian Marclay's Cascade (1989), which presents a tumbling mass of magnetic tape as a sculpture, thereby eliminating the tape's original purpose: playing sound. See also John Cage's Cartridge Music (1960), which uses phonograph cartridges attached to contact microphones in order to amplify the sound of the cartridges and everyday objects.

In this essay, I situate Santoro's work within the socially and politically

charged histories of textiles and music technology, showing the ways that Sonic

Fabric can be understood as partaking in and rebelling against a problematic

global economy of both textiles and technology. I also interpret the participation

in national and global economics from a gendered standpoint.

Because Santoro's artist website and mainstream press for Sonic Fabric

emphasize Santoro's process and materials, I place these concepts in historical

and global context. Her website shows a video of a large, noisy textile loom

weaving audio tape (emphasizing the production of this fabric). In an interview

with CNN, Santoro notes:

> Sonic Fabric is woven at a small, family-run textile mill in New England on an
> astoundingly beautiful 1940s Dobby loom that was salvaged by the mill especially for
> this purpose -- it has a special shuttle that just happens to handle cassette tape perfectly.[78]

Though the interviewer does direct the conversation towards the location

and method of production, Santoro's response includes references to technique

("woven," "Dobby loom," "special shuttle," and the handling of cassette tape),

time and place ("New England," "textile mill," "1940s"), adaptation of old

technology ("salvaged by the mill"). Santoro's comments indicate a desire to

---

[78] Arion McNicoll, "Isn't your tie a little loud? Sonic fabric, the textile woven from cassette tape," *CNN*, June 13, 2013, https://www.cnn.com/2013/06/13/tech/innovation/sonic-fabric-recycled-cassette-tape/index.html.

situate her Sonic Fabric historically – a textile intimately connected to its own making on a 1940s loom. The emphasis on weaving techniques and machinery in her interview comments, on her website, Youtube[79], and Vimeo[80] suggests that the meaning of her work is connected to her working process; when we are given vivid information about her working process, we can no longer divorce our understanding of the textile from its creation. I argue that the story about the loom and the recordings of the mill become part of the story of Sonic Fabric and art made with it (*Sonic Scroll*, *Tell-Tail Sail-Score*, *Voidness Dress*, *Sonic Superhero Dress #1*, *Fishdress (The Musical Suit)*, *Sails*, *Tell-Tail Sails (After Sandy)*, and others).[81]

Santoro's comments invite us to romanticize the textile mill, to imagine the equipment as "astoundingly beautiful," situated in a "small, family-run" business (a statement that precludes any possibility of her cooperation with a large, corporate mill), and located in the United States. The use of the Dobby loom "salvaged by the mill especially for this purpose" situates her work in an

[79] Alyce Santoro, "Sonic Fabric Factory," Youtube.com, June 23, 2008, video, 5:59, https://www.youtube.com/watch?v=qDF2N5IY5cA.
[80] Alyce Santoro, "The Making of Sonic Fabric, a textile made from cassette tape," Vimeo.com, June 25, 2011, video, 2:06, https://vimeo.com/25607079.
[81] Alyce Santoro, "Sonic Fabric," AlyceSantoro.com, http://alycesantoro.com/sonic_fabric.html. Note that Santoro also sells Sonic Fabric Neckties and Sonic Fabric Pieces that might be understood as art or as merchandise.

ethos that values reusing and recycling – she seems to communicate clearly that artists can give old, defunct equipment new life. Her work not only uses obsolete technology for the fabrics itself (the audiocassette tape woven into Sonic Fabric), but repairs and reuses obsolete machinery in the working process. As such, Sonic Fabric might be read as a political statement that encourages "green" or eco-friendly production of art.

According to Santoro's website, "Santoro refers to many of her multimedia works as *philosoprops* – devices intended to be used (or at least imagine being used) to demonstrate a concept, catalyze an action, challenge perception, or spark a dialog."[82] While it might be more accurate to consider Sonic Fabric to be new material used for Santoro's art, rather than the artwork itself, (much like the distinction between oil paint and the Mona Lisa), Sonic Fabric itself also serves as a *philosoprop*. Additionally, the concept of *philosoprop* can be used to understand Santoro's work.

Santoro might want us to change our day-to-day behaviors around trash ("catalyze an action"), and she might want us to remember that music can create trash, too (an idea that "[challenges the perception]" that music is above petrocapitalism). When the world has forgotten that tape cassettes were ever new

---

[82] Alyce Santoro, "Information," AlyceSantoro.com, http://www.alycesantoro.com/information.html.

85

or cool, Santoro reminds us that all our old tape cassettes are sitting around somewhere, refusing to biodegrade. Another "concept" that Sonic Fabric demonstrates is that trash can be used to make art, an idea that has existed in various forms throughout the 20th century.

Art made from trash, recycled materials, or found objects existed long before Santoro was born. Early 20th century dada art used *objets trouvés* and included Marcel Duchamp's *Bottle Rack (Port-Bouteilles)* (1914/1959) and *Fountain* (1917/1964), which reinterpreted existing objects as art objects (a bottle rack and a urinal, respectively). These works also challenged ideas about the role of an artist.

 Cubist artists from this time period used recycled materials in collage techniques such as *papier collé* (pasted paper). For example, Georges Braque's *Fruit Dish and Glass* (1912) included *faux bois* wallpaper from a local shop, and Picasso's *Bottle of Vieux Marc, Glass, Guitar and Newspaper* (1913), contained newspaper scraps. These collage works challenged ideas of what materials "count" as art, but unlike like Santoro's work, did not raise ecological questions. Braque and Picasso used wallpaper and newspaper for aesthetic and conceptual reasons; if there was a political statement, it was not about questioning the way we consume and dispose of material.

The *Arte Povera* movement also embraced non-traditional and "poor"

materials in art. In 1967, Genoese critic Germano Celant invented the term *Arte Povera*, or impoverished art, to describe "for a group of Italian artists who, from the late 1960s, attempted to break down the 'dichotomy between art and life' (Celant: Flash Art, 1967), mainly through the creation of happenings and sculptures made from everyday materials."[83] These works used "unglamorous materials" and resisted the idea that art was meant to imitate reality.[84] Notable artists include Jannis Kounellis, whose art "included raw materials such as stone, cotton, wool and coal, and *objets trouvés* such as bed-frames, doors and, since 1969, shelves."[85] Mario Merz is also associated with this movement, embracing the "juxtaposition of 'poor' materials, such as earth, sticks and wax, with materials suggestive of modern progress and sophistication, such as neon or glass panels."[86] Another example is artist Michelangelo Pistoletto, whose "approach to Arte Povera combined the 'poor' everyday element, taken from life, with cultured features derived from the repertory of museums, as in Venus of the Rags," a 1967 work "in which an academic statue of the goddess, presented as a ready-made, provides a spectacular contrast to a mass of multicoloured

---

[83] "Arte Povera," *Grove Art Online,* 2003, https://doi-org.proxy.lib.duke.edu/10.1093/gao/9781884446054.article.T004357.
[84] Ibid.
[85] Antonello Negri, "Jannis Kounellis," *Grove Art Online*, 2003, https://doi-org.proxy.lib.duke.edu/10.1093/gao/9781884446054.article.T047778.
[86] Ibid.

rags."[87]

Later, Jeff Koons produced several works with found objects that hearkened back to Duchamp's ideas. For example, Koons' "Pre-New" works (1979) include a deep fryer, pot, speaker, toaster, coffee pot, heater, humidifier, refrigerator, vacuum, teapot, which are mounted individually on fluorescent tubes.[88] The collection also includes a telephone mounted on mirrors. Like Duchamp, he uses found objects and surprises viewers with his ideas of what "counts" as art.

More recently, work with recycled materials includes Tim Noble and Sue Webster's trash sculptures, which reveal detailed images made from shadow when lit from the right angle (see *Dirty White Trash (with Gulls)* (1998), *Wasted Youth* (2000), *The Original Sinners* (2000), *Cheap N' Nasty* (2000), *Falling Apart* (2001), and others).[89] The visceral effect of large piles of garbage makes it likely that viewers will also notice an ecological theme in these works.

---

[87] Renato Barilli, "Michelangelo Pistoletto," *Grove Art Online,* 2003, https://doi-org.proxy.lib.duke.edu/10.1093/gao/9781884446054.article.T067944.

[88] Jeff Koons, "Pre-New," JeffKoons.com, http://www.jeffkoons.com/artwork/pre-new. The use of neon tubes may also be a response to the work of Mario Merz, an artist from the *Arte Povera* movement who pierced everyday objects such as bottles and umbrellas with neon tubing. See "Mario Merz," Guggenheim.com, https://www.guggenheim.org/artwork/artist/mario-merz. Bruce Nauman is also well-known for his work with neon tubes, as is Dan Flavin.

[89] Tim Noble and Sue Webster, "Artwerks," TimNobleandSueWebster.com, http://www.timnobleandsuewebster.com/artwerks.html.

Unlike other artworks using recycled objects or trash, Santoro's Sonic

Fabric encourages us to consider the local and global consequences of obsolete

music technology, a type of trash that hasn't quite made the headlines in the way

that other plastic trash has. Average consumers are becoming more aware of the

effects of household and grocery-related trash (yogurt cups, plastic shopping

bags, plastic wrap, etc.). Some Americans purchase reusable bags to stop using

single-use plastics to carry groceries, not realizing that organic cotton bags are

sometimes even more harmful for the environment.[90] These choices are likely

influenced by information about plastic, which is becoming more available and

easier to access. For example, NPR reports that plastic bags "clog drains and

cause floods, litter landscapes and kill wildlife," with "more than 240 cities and

counties passing laws that ban or tax them since 2007."[91] Many people are forced

to reckon with pollution when their home states ban plastic bags.[92]

Awareness of the environmental impact of our electronic devices,

including the pollution triggered by the music industry, seems lacking. I have

never met a person who knows or cares where the pieces of their first iPod are

[90] Greg Rosalsky, "Are Plastic Bag Bans Garbage?," NPR.org, April 9, 2019,
https://www.npr.org/sections/money/2019/04/09/711181385/are-plastic-bag-bans-garbage.
[91] Ibid.
[92] "State Plastic and Paper Bag Legislation," NCSL.org, National Conference of State Legislatures, January 24, 2020, https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx.

located. This problem is starting to change: Rolling Stone recently published an

article on the environmental impact of streaming music,[93] which cites scholar

Kyle Devine's work on the environmental impact of music and which is now

available from MIT Press.[94] In 2013, the Washington Post released an article

about the sustainability of CDs. The author, Brian Palmer, points out that CDs

are sold in plastic jewel-cases, wrapped in more plastic, and delivered on

"pollution-belching trucks."[95] Despite that, streaming uses electricity, and "if you

plan to listen to a song dozens of times, it might be slightly greener to buy the

CD or download the MP3 file once than to stream it over the Internet again and

again."[96]

These arguments are built on the idea that less energy use is better, but do

not calculate the long-term effect of music trash that doesn't biodegrade. In the

MIT Press book summary for Kyle Devine's "Decomposed," we find that "before

1950, 78 rpm records were made of shellac, a bug-based resin."[97] But "between

---

[93] Jon Blistein, "Is Streaming Music Dangerous to the Environment? One Researcher is Sounding the Alarm," RollingStone.com, *Rolling Stone*, https://www.rollingstone.com/music/music-features/environmental-impact-streaming-music-835220/.

[94] Kyle Devine, *Decomposed: The Political Ecology of Music*, (Cambridge: MIT Press, 2019).

[95] Brian Palmer, "Depending on how you listen, CDs may be the environmentally sensitive choice," WashingtonPost.com, *The Washington Post,* May 27, 2013, https://www.washingtonpost.com/national/health-science/depending-on-how-you-listen-cds-may-be-the-environmentally-sensitive-choice/2013/05/24/9a6ff63c-c15e-11e2-bfdb-3886a561c1ff_story.html.

[96] Ibid.

[97] Kyle Devine, *Decomposed: The Political Ecology of Music*, (Cambridge: MIT Press, 2019).

1950 and 2000, formats such as LPs, cassettes, and CDs were all made of petroleum-based plastic."[98] When we are done using these items, what happens to the pieces?

In "Making and Breaking: Electronic Waste Recycling as Methodology," Daniël Ploeger writes:

> A substantial part of discarded electronics devices in Europe and the United States are exported to developing countries, where they are eventually recycled through environmentally harmful methods or dumped in unprotected areas, causing severe environmental damage accompanied by a range of socio-cultural problems. Despite this, public debate on digital technologies in post-industrial countries has been primarily focused on the economic and social benefits of technological innovation. Digital performance arts practices have largely been complicit in this narrative.[99]

In this reading of discarded electronic devices, Santoro's work might be seen as diverting trash from environmentally and socially harmful exportation processes – and potentially creating a model for future artists, researchers, and manufacturers of e-textiles and wearable technologies. It is possible to read Santoro's work as a rebellion against the "environmentally and socially harmful exportation processes," and to see her work as disrupting the dominant narrative

---

[98] Ibid.

[99] Daniël Ploeger. "Making and Breaking: Electronic Waste Recycling as Methodology," in *Digital Bodies* (Palgrave McMillan, 2017): 49.

of "economic and social benefits of technological innovation" in digital

performance arts.[100]

On the other hand, Ploeger notes that the outsider-observation method

has typically been used to analyze the ethics of recycling used technology

(usually conducted by toxicologists at dump sites) and tends to tends to produce

a one-sided understanding of the problem.[101] While "informal e-waste recycling

in West Africa and East Asia is often perceived solely as a harmful activity for

health and environment," "local perspectives are more ambiguous."[102] Ploeger

writes that while workers are "usually aware of health hazards," "recycling is

also considered a reliable and substantial source of income in an economic

context where often few other viable strategies to make a living are available."[103]

Given the important economic role of second-hand and broken electronics

for people who have few resources, it is important for scholars, designers and

artists not to misuse rhetoric in a way that makes Santoro's working process (and

the process of other artists who recycle or re-use electronic waste) appear to pave

the way towards a "green" and ethical management of electronic waste.

---

[100] Daniël Ploeger. "Making and Breaking: Electronic Waste Recycling as Methodology," in *Digital Bodies* (Palgrave McMillan, 2017): 49-51.
[101] Ibid., 52.
[102] Ibid., 51.
[103] Ibid.

Santoro's work can also be understood within the textile economy, an

industry that has been frequently and persistently associated with gross human

rights violations that have typically targeted women in the United States and

globally.[104] For example, in the mid-nineteenth century, the high number of city

women desperate for employment made it easy for employers engaged in

elaborate tactics to lower wages, such as "claiming shoddy workmanship and

then paying less than the price agreed upon, paying in kind rather than in cash,

paying in depreciated script, or withholding pay for a month or more."[105]

Sewing for extremely low pay was thought to be the only viable option for

women who needed to make money for their families, as the only alternative was

prostitution. While Santoro encourages us to read her work as evolving from an

idyllic, family friendly textile mill in charming New England, the history of post-

industrial textile and garment manufacturing suggests an uglier reality.

Santoro's working process can also be understood as situated within a

history of crazy quilt practices in the United States, which were often considered

as a form of female resistance and self-expression. This form of quilting used

discarded material to form a textile, just as Santoro's work uses discarded

[104] For a discussion of the abuse of female textile workers over the last two centuries, see Joan M. Jensen
and Sue Davidson, editors, *A Needle, a Bobbin, a Strike: Women Needleworkers in America* (Philadelphia:
Temple University Press, 1984).
[105] Ibid., 23.

audiocassette tape to form her Sonic Fabric. Joan M. Jensen considers crazy

quilting to be a form of resistance to home extension agents, who pressured

women to abandon crazy quilts and focus on "neat, plain sewing and

mending."[106] Jensen notes one woman who places quilting in opposition to

"woman's work":

> When I'm dead and gone there ain't anybody goin' to think o' the floors I've swept and the tables I've scrubbed, and the old clothes I've patched, and the stockin's I've darned … But when one of my grandchildren or great-grandchildren sees one o' these quilts, they'll think about Aunt Jane, and wherever I am then, I'll know I ain't forgotten.[107]

Another woman used her "quilt squar'" to help her survive times where

"[she'd] git so wearied [she] couldn't take delight in nothing."[108] In these

accounts, quilting from discarded fabric is presented as a form of sewing that

stands outside of exhausting and unappreciated women's work and acts as a

form of resistance. Similarly, Santoro's Sonic Fabric adoption of rejected

materials (audiocassette tape and an old loom) resists classification as domestic

work. While the manufacture of regular fabrics such as cotton are still poorly

paid and anonymous jobs, Santoro's use of cassette tape transforms fabric

---

[106] Joan M. Jensen and Sue Davidson, editors, *A Needle, a Bobbin, a Strike: Women Needleworkers in America* (Philadelphia: Temple University Press, 1984), 16.
[107] Ibid.
[108] Ibid., 17.

production into a viable means of expression, career development, and economic support for Santoro.

3.4 Anna Biró: Resisting Normative Femininity in Responsive Non-wearable Textiles

When I first began research for this article, I was excited and dismayed by existing photos of responsive garments. Compared to my memories of pre-cellphone-era fashion in the American Midwest (which was drowning in denim, sneakers, and bracelets made of boiled toothbrushes) the responsive garments in the last decade seemed magical. Today's garments move, change color, become transparent, inflate, reveal skin, change temperature, and track intimate experiences in real time. Many of these garments are captured in publications such as *Smart Textiles for Designers: Inventing the Future of Fabrics*[109] and *Fashionable Technology: The Intersection of Design, Fashion, Science, and Technology*,[110] and to a lesser extent in *Technotextiles 2: Revolutionary Fabrics for Fashion and Design, 2nd Ed.*,[111] which focuses more heavily on textile photography than representation of humans.

---

[109] Rebeccah Pailes-Friedman, *Smart Textiles for Designers: Inventing the Future of Fabrics* (London: Laurence King Publishing, 2016).
[110] Sabine Seymour, *Fashionable Technology: The Intersection of Fashion, Science, and Technology* (Austria: Springer-Wien, 2009).
[111] Clarke, Sarah E. Braddock and Marie O'Mahoney, *Techno Textiles 2: Revolutionary Fabrics for Fashion and Design, 2nd Ed.* (New York: Thames and Hudson, 2008).

The photos are both magical and eerie. If you can resist the inherent

novelty and appeal of the photos, you may start to notice that the documentation

is quite similar to existing photography in the fashion industry. The women are

very beautiful, and very thin – perhaps dangerously so. With a few exceptions,

they are overwhelmingly Caucasian. The male models get to wear the athletic

gear, tactical gear, and medical devices, and the women are stuck wearing

dresses that are meant to become transparent,[112] that change shape to reveal the

model's legs,[113] that retract into a large hat leaving the model completely nude,[114]

that are sprayed onto the body out of a can,[115] or with hemlines so short that I

wondered if the designer forgot to give the model some pants.[116] I don't wish to

imply that women need to hide their bodies, or that female sensuality is sinful or

needs to be suppressed. I would like to see women portrayed as engineers,

---

[112]See Daan Roosegaarde and Studio Rosegaarde's *Intimacy* series, which includes dresses that reveal the model's body when her heartbeat increases or when she is aroused – "the garment creates a sensual play out of the act of disclosure." Interestingly, the male suit in this series becomes transparent when the wearer is lying. Rebeccah Pailes-Friedman, *Smart Textiles for Designers: Inventing the Future of Fabrics* (London: Laurence King Publishing, 2016), 154-159.

[113] See fashion designer Hussein Chalayan's *One Hundred and Eleven* Paris fashion show from 2007. Images are available in Rebeccah Pailes-Friedman, *Smart Textiles for Designers: Inventing the Future of Fabrics* (London: Laurence King Publishing, 2016), 17.

[114] See also the professional website of Adam Wright, the senior animatronic designer for fashion designer Hussein Chalayan's *One Hundred and Eleven* Paris fashion show from 2007. Adam Wright, "Hussein Chalayan: One Hundred and Eleven," Adam-Wright.com.

[115] See Manel Torres' work with *Spray-on Fabric* (since 1997, 2007) and *Spray-on Bikini* (2007). Sabine Seymour, *Fashionable Technology: The Intersection of Fashion, Science, and Technology* (Austria: Springer-Wien, 2009), 86-88.

[116] See the back of one of the dresses in the *Intimacy* series by Daan Roosegaarde and Studio Rosegaarde, which conceals nothing. Rebeccah Pailes-Friedman, *Smart Textiles for Designers: Inventing the Future of Fabrics* (London: Laurence King Publishing, 2016), 157.

surgeons, researchers, authors, lawyers, and artists. These magical, novel and

cool technologies are still reifying the idea that women are pretty things and

meant to be looked at, watched, and examined - but only if we are white, young,

thin, cisgender, and able-bodied. The responsibility for these types of messages

does not lie with the authors and publishers; the excellent publications I have

cited are compilations of hundreds of artists and designers who would have

photographed and documented their works themselves.

These types of photos are not harmless. Scholars Burns and Lafrance note

that "late twentieth century popular culture is super-saturated with discourses of

body mastery and self-determination."[117] Citing Naomi Wolf's research, Burns

and LaFrance suggest that "these kind of discourses, rhetorics, and narratives are

targeted primarily at girls and women," and note Susan Bordo's assertion that

"the dark underside of the practices of body transformation and rearrangement

reveals botched and sometimes fatal operations, exercise additions, eating

disorders" – "all of which affect women far more than they do men. Women, as

constrained but active subjects, are literally dying to be beautiful."[118] According

to Sandra Lee Bartky, Susan Bordo, Susan Brownmiller, Naomi Wolf, Lori Burns

---

[117] Lori Burns and Melisse Lafrance, *Disruptive Divas: Feminism, Identity and Popular Music* (New York and London: Routledge, 2002), 105.
[118] Ibid., 106. See also Susan Bordo, *Unbearable Weight: Feminism, Western Culture and the Body* (Los Angeles: University of California Press, 1993), 67.

and Mélisse Lafrance, the beauty industry "is in no way gender-neutral; it is an industry devoted to the thorough colonization of female bodies."[119] The close association of responsive textile technologies with the fashion industry precludes a reading of wearables as cool, fun, novel, and innocent as they first appear.

Textile artist and costume designer Anna Biró resists the tendency to idealize thin, white female bodies. In my article, I show that Biró's responsive textile installation, *Rope of Hope* (part of her three-part *Text in Textiles* installation), seems to suggest femininity, but disrupts and resists gendered standards of the beauty industry.

Rope of Hope is a woven rope suspended from the ceiling that makes sound when squeezed. The shape of the rope is relatively straight when it hangs undisturbed; the shape is mutable when crumpled or gently squeezed. As noted on Biró's website:

> Inserted within these woven and knitted structures are sensors that are triggered through interaction with the public. These sensors will generate fragments of narratives from an archive of recorded interviews with recent immigrants to Montreal that I inherited from sociologist/anthropologist, in conjunction with sounds and voices of a more personal nature. The stories had a strong impact on me. I did not want to lose this multivoiced history, and so I transferred them to digital format before beginning the weaving process. Text in Textile' functions as

---

[119] Burns and Lafrance, 106. The authors support their claim with research by Sandra Lee Bartky, *Femininity and Domination: Studies in the Phenomenology of Oppression* (New York: Routledge: 1990), Susan Bordo, *Unbearable Weight: Feminism, Western Culture and the Body* (Los Angeles: University of California Press, 1993); Susan Brownmiller, *Femininity* (Linden Press/Simon and Schuster, 1984), and Naomi Wolf, *The Beauty Myth: How Images of Beauty are Used Against Women* (New York: W. Morrow, 1990).

a metaphor for the fabric of our society (both on a local and global scale), our interconnectedness as social beings, and a personal desire for communication and collaboration.[120] (*formatting changed*)

The voice recordings sound clearly female, but the textile does not suggest the shape of a female body. Because this responsive textile work does not visually suggest a human form, there is no pressure on female-identifying people to adhere to a specific female body shape.

Figure 8: Anna Biro's *Rope of Hope*

---

[120] Anna Biró, AnnaBiro.com, http://www.annabiro.com/. Photo credit Guy L'Heureux for Gallery MAI - Montreal Arts Interculturels, 2010.

The source of the recordings also changes the focus of this work. It is not clear which recordings are anthropological and which are "of a personal nature."[121] Nevertheless, because *Rope of Hope* is part of the *Text in Textile* series, and because the series as a whole incorporates "fragments of narratives from an archive of recorded interviews with recent immigrants to Montreal," people interacting with *Rope of Hope* may be more likely to understand femininity as related to story, communication, narrative, immigrant status, and travel (the recent move to Montreal), and less likely to rigidly interpret femininity as white and thin.

If we accept the possibility that *Rope of Hope* might suggest disembodied femininity, the stunning web of responsive silver threads in *Rope of Hope* suggest that femininity is still beautiful, still meant to be looked at, and meant to be touched. It is possible to view the functionality of *Rope of Hope* as conforming to these feminized ideals (beautiful, touchable), but very disruptive to the bodily beauty standard that oppresses so many women, young girls, and female-identifying people. Biró's *Rope of Hope* might be understood as an unusual and complex representation of femininity – one that is stereotypically beautiful and touchable, but that is also independent of the thin, white, non-disabled, young,

---

[121] Anna Biró, AnnaBiro.com, http://www.annabiro.com/.

cisgender, normative body that haunts popular culture, media, fine art,

advertising, and other arenas, and that affects daily lives of female-identifying

people.[122]

4. Conclusion

Many responsive technologies are useful, pragmatic, and profitable. Now

that computers are commonplace, we have begun to expect our clothing to

respond to our needs in real time as well. Wristwatches track the number of steps

we take in a day as well as the efficiency of our sleep, tattoos can measure

glucose, and sweaters can change temperature based on the weather.

In a cultural landscape where everything must be useful, art might seem

unnecessary; a fuzzy purposeless thing for upper-class people with disposable

income and a desire to feel modern, open-minded, and culturally competent.

However, my research suggests that responsive art, design, fashion, and textiles

can serve as catalysts for social change. In particular, the work of Joanna

Berzowska and XS Labs, Yuri Suzuki, Alyce Santoro, and Anna Biró suggest that

---

[122] For a discussion of the complex systems of meaning that women must navigate multiple times a day for the simple act of getting dressed, see Sophie Woodward's ethnographic treatment of women, fashion, and the construction of identity. Sophie Woodward, *Why Women Wear What They Wear* (Oxford, New York: 2007).

art is not only expressive, but also socially and culturally functional. Embedded in these works we may notice complex and conflicting messages.

Responsive dresses by Joanna Berzowska and XS Labs help us imagine new clothing for female self-defense. In contrast with historical battle armor, which was created for able-bodied men as they perform traditional masculinity, *Distract* and *Reclaim* are built for female bodies to wear as they disrupt a traditional narrative of passive, gentle femininity. The design, functionality, and documentation of *Distract* and *Reclaim* acknowledge the persistent problem of sexual violence towards women and female-identifying people. *Distract* and *Reclaim* contain an embedded fantasy of responsive clothing that aids women in the too-common need for self-defense. These dresses also ask us other important questions: why is our society so broken that women need responsive armor? Why isn't the problem of sexual violence being addressed more thoroughly and rapidly? Should a woman's dress be responsive, or should men?

Yuri Suzuki's work also contains social messages. Whether intentional or not, Suzuki's work asks us to consider whether art objects themselves are accessible, and whether the environment in which art is displayed can improve accessibility. Taken with a broader view, his work reminds us to consider accessibility in our planning of physical environments. His work also suggests

that technological responsivity might be used to support accessibility in the future.

Alyce Santoro's work, on the other hand, asks us to consider materiality. Her use of defunct technology (audiocassette tape) reminds us that old technology usually becomes trash: her work is surprising because the tape cassettes become useful and beautiful again. Her work suggests that whether we are making art, everyday objects, or anything in between, we must consider the birth and death of the materials, not just the functional life. When we see a cool LED dress, who made the LEDs? Were they paid an appropriate wage? Were they paid at all? Was the the recycling work safe? Is it economically viable? Is it environmentally sustainable? What objects do we use every day that quickly become trash?

Anna Biró's work encourages us to consider alternative methods of capturing femininity. While traditional art, fashion, design and advertising usually perpetuate normative beauty ideals (white, thin, female, able-bodied, cisgender, etc.), Biró's work resists those narratives. Because *Rope of Hope* sighs like a woman, but lacks resemblance to a human shape, this work shifts our attention away from feminine beauty norms and towards women's voices. *Rope of Hope* encourages the public to focus on what a woman expresses instead of how she is shaped.

Figure 9 summarizes ethical questions raised by Berzowska/XS Labs, Suzuki, Santoro, and Biró. My research suggests that specific artworks and design projects can be thoughtfully analyzed for concrete ethical concepts which can be used to inform the design, photo documentation, dissemination, purchase, and use of modern technologies. Artists, designers, and businesspeople may find this data useful as they develop physical prototypes, choose and communicate with photographers, plan advertising campaigns, or hire subcontractors.[123] I also hope that future scholars, artists, and designers will contribute to this ongoing discourse on ethical responsive and wearable technologies. I present my findings in the following table. Consider printing it out and testing it against your current projects.

This space intentionally left blank.
The table is presented on the next page so that it can easily be printed and used.

---

[123] Subcontracting can often spiral out of control in the garment industry, resulting in elaborate and opaque supply chains which prevent businesses from recognizing human rights violations involved in the production of their products. The problem of opaque and unethical supply chains is also relevant to artists, who may wish to examine the way their raw materials are sourced and created. For an example of the way one state government is attempting to fight opaque supply chains, see "The California Transparency in Supply Chains Act," State of California Department of Justice, https://oag.ca.gov/SB657.

Ethical Considerations for the Design and Documentation of Wearable Technologies, Responsive Textiles, and Haptic Sound Art	
Considerations	*Artist Referenced*
If you design or create clothing or wearables, can the garment or wearable be designed to account for the needs of female, transgender, and non-binary people? Can the fit of the garment be designed in such a way that addresses body diversity (including but not limited to weight, disability, and gender expression)? Does the garment adopt standard female body ratios used by the fashion industry? Consider redesigning: - cup size - waist to hip ratio - size range - other size and shape elements that reflect stereotypes about women's bodies. For example, compare the drastically different size options for bras in the United States (limited sizes where large bust is thought to be a result of higher body weight, resulting in the need for a large band) and England (expanded sizes where bust size is independent of weight, including small band and large cup). Can you create systems in your place of business to track discrimination and harassment against women, transgender people, non-binary people, disabled people, people of color, and other groups? - Include protected categories, but don't be limited by them; legal policies can sometimes be outdated or can overlook relevant categories. Rather than increasingly armoring women, can you change the way you teach boys and men about touch? - If you have male children, have you taught them about consent? - If you are in a position of power in a business or organization, have you created enforceable policies against harassment and violence? - Are you afraid to enforce those policies if a member of your organization has crossed the line? - If you identify as male, are you leading by example?	Joanna Berzowska and XS Labs

• Do you ever notice yourself explaining away white privilege, male privilege, harassment, and violence? • Do you ever notice your peers or subordinates explaining away white privilege, male privilege, harassment, and violence?	
If you work in art or design, is there a way to use responsive or assistive technology to make your products more inclusive to children and people with disabilities? If you create, design, or manage physical environments such as concert halls, schools, government buildings, homes, galleries, museums, or outdoor spaces, do your environments respond to humans, or do they require humans to adapt? In the physical environments that you design or manage, have you considered diverse needs instead of "average" ones? If you own or design concert halls, museums, galleries, outdoor spaces, or other physical environments, have you considered the ways that your building or space might exclude certain visitors? If you own or design space, have you sought relevant feedback about the way that space has the potential to exclude people? • This feedback might include informal requests from visitors or users of your space. • Alternately, hiring a disability access specialist might be beneficial. • Consider consulting academics who specialist in race, gender and sexuality, disability studies, and post-colonial studies to add to your understanding of how your space welcomes or excludes people. Have you thought radically about the accessibility of your planned design or artwork? If so, can you alter your plans to make the work more accessible? Perfection is not possible, but improvement usually is. If your career involves presenting art and music, can you adjust performance spaces to make them more inclusive? • If needed, base your solutions on those of other organizations.	Yuri Suzuki

- Solutions might include designated quiet spaces, encouragement to leave and enter if your health condition requires it, large format programs, available chairs when people are expected to wait in line, etc. - Make sure to seek relevant feedback from people about your proposed or existing solutions. - This might take the form of hiring a disability access specialist to evaluate your organization, your content, and your physical spaces. - You may also benefit from requesting feedback from your visitors (make sure to request feedback in various accessible ways, including large print signs or programs, recordings, or other options developed with the aid of a disability access specialist). - Again, consulting scholars in race, gender and sexuality, disability studies, and post-colonial studies may add to your understanding of how your space creates or hinders a culture of inclusivity.	
Given that obsolete music technology is part of the global trash problem, can you find ways to be repurpose it in ways that are useful or beautiful? For any business or artistic project that involves physical materials, evaluate whether new materials or recycled ones would have less environmental and global impact. Would the lower impact material be an acceptable option? Whether you work in government, academia, business, or advertising, what rhetoric are you using related to recycling? Can you make a greater effort to base your statements in fact, even if the facts seem to conflict? If you are an artist, what steps can you take to source artistic materials ethically? Seek raw materials with a documented and transparent supply chain. If your company designs and manufactures everyday items, what steps can you take to source the materials as ethically as possible? Seek raw materials with a documented and transparent supply chain.	Alyce Santoro

If you are an artist, designer, or businessperson who works with responsive garments, can you source the materials ethically? Seek raw materials with a documented and transparent supply chain.
 	
Whether you are a businessperson, artist, designer, or a combination of these, do you know whether you are purchasing materials from companies who pay their employees fairly and who enforce safe working conditions for their workers?
    • If you don't know, can you find out?
    • Are there ways to change your purchasing habits to support safe and human working environments?
    • Ethical choices may be disruptive or expensive at first, but keep in mind that if you successfully make these changes, your ethical behaviors can serve as potent advertising that benefits you and your business.
 	
Can you help your customers understand the cycles of creation, use, and obsolescence of materials?
 	
Can you help customers change their buying habits and reduce global trash?
 	
Many people feel good about using material just because it is recyclable. Research the recycling process for your intended raw materials before you decide whether recycled materials are an ethical choice for your business. Have you made the choice to use recycled or new materials, or did it happen by accident?
 	
Have you considered closed-loop recycling (allowing your customers to send back bottles or raw material, then process it in your own facilities)? Other countries are currently cleaning up after American purchasing habits; what steps can help you take responsibility for the waste your business creates?
 	
Physical materials used in music distribution (cassette tape, CDs, jewel cases, shrink wrap, energy use for streaming) affect local and global economies. If you are involved in the creation and sales of music, can you find ways to reduce plastic packaging? Can you find other ways to reduce energy use for your projects?	

Whether you are an artist, designer, or corporate business, can you create artwork, wearables, and products that resist female beauty norms? Try examining your previous photo documentation or advertising campaigns. • Does your photo documentation or advertising promote desirability of white, cisgender, thin, able-bodied women? • Can you adjust your future photo documentation or advertising in ways that send more healthy messages? • Have you considered the ways that a more ethical approach to photography can impact or improve your business? Can you design or redesign artwork and wearables to enhance female agency? Examine your upcoming art or design projects. Does the product or work of art make women look helpless or passive? Can your plans be adjusted? Examine your upcoming art or design projects: do they functionally encourage women into a passive role? Can the functionality of your art or design be adjusted in ways that promotes female agency? Does your artwork, design, or business product promote cisgender bodies as normal or preferable? How can you change or adjust your plans to send more positive messages about gender expression?	Anna Biró

Figure 9: Ethical Considerations for the Design and Documentation of Wearable Technologies, Responsive Textiles, and Haptic Sound Art

My research is a starting point for the nascent field of ethical wearables and responsive technology. I hope that my research will spur further investigations in this area, and that future studies will also consider the need for

109

practical and useable research results. I do not expect that readers will accept my

table as precious and immutable. I hope that they will try using it, adding to it,

and changing it. I hope they will share their version with collaborators, develop

it further, and examine other artwork in order to develop additional ethical

considerations that belong in this list. This is a living document.

Bibliography

"About Dezeen." Dezeen.com. https://www.dezeen.com/about/.

"Advisory on Pufferfish." FDA.gov. Updated January 17, 2014.
    https://www.fda.gov/food/alerts-advisories-safety-information/advisory-
    puffer-fish.

"Arte Povera." *Grove Art Online,* 2003. https://doi-
    org.proxy.lib.duke.edu/10.1093/gao/9781884446054.article.T004357.

Andrews, Kate. "Looks Like Music by Yuri Suzuki." Dezeen.com, September 15,
    2013, https://www.dezeen.com/2013/09/15/looks-like-music-by-yuri-
    suzuki/.

Baker, Camille. "Critical Interventions in Wearable Tech, Smart Fashion, and
    Textiles in Art and Performance." In *Digital Bodies*. Palgrave McMillan,
    2017.

Barthes, Roland. "History and Sociology of Clothing" in *The Language of Fashion*.
    Oxford, New York: Berg, 2006.

Barthes, Roland. Matthew Ward and Richard Howard, trans. *The Fashion System*.
    New York: Hill and Wang, 1983.

Bartky, Sandra Lee. *Femininity and Domination: Studies in the Phenomenology of
    Oppression.* New York: Routledge: 1990.

Bent, Ian D., David W. Hughes, Robert C. Provine, Richard Rastall, Anne Kilmer,
    David Hiley, Janka Szendrei, Thomas B. Payne, Margaret Bent and
    Geoffrey Chew. "Notation." *Oxford Music Online*, revised 2014. https://doi-
    org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.20114.

Berzowska, Joanna and XS Labs. "People." XSLabs.net. Accessed November 6th,
    2019, http://www.xslabs.net/people.html.

Berzowska, Joanna and XS Labs. *Seven Years of Design Research and
    Experimentation in Electronic Textiles and Reactive Garments*. Montreal, 2010.
    http://xslabs.net/catalogue-pdf/XS_catalogue.pdf.

Biró, Anna. AnnaBiro.com. http://www.annabiro.com/.

Blendis, Stefanie and Arion McNicoll. "Liquid lights and musical posters: Welcome to the world of electric paint." CNN, May 23 2013. https://www.cnn.com/2013/05/23/tech/innovation/bare-electrically-conductive-paint.

Blistein, Jon. "Is Streaming Music Dangerous to the Environment? One Researcher is Sounding the Alarm." RollingStone.com. Rolling Stone. https://www.rollingstone.com/music/music-features/environmental-impact-streaming-music-835220/.

Bordo, Susan. *Unbearable Weight: Feminism, Western Culture and the Body*. Los Angeles: University of California Press, 1993.

Botstein, Leon. "Modernism," *Grove Music Online*, 2001. https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.40625.

Brownmiller, Susan. *Femininity*. New York: Linden Press/Simon and Schuster, 1984.

Burkholder, Peter, Donald J. Grout, and Claude V. Palisca. *A History of Western Music.* Canada: WW. Norton and Company, 2019.

Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge, 1999.

Chagall. "Performing Electronic Music with Gesture: Chagall TedxClerkenwell." Accessed 7/6/2018. https://www.youtube.com/watch?v=OE361wobkiE.

Clarke, Sarah E. Braddock and Marie O'Mahoney. *Techno Textiles 2: Revolutionary Fabrics for Fashion and Design, 2nd Ed*. New York: Thames and Hudson, 2008.

Cui, Zheng, Felipe R. Poblete, Guangming Cheng, Shanshan Yao, Xiaoning Jiang, and Yong Zhu. "Design and Operation of Silver Nanowire Based Flexible and Stretchable Touch Sensors." Journal of Materials Research 30, no. 1 (2015): 79-85.

de Beauvoir, Simone. *The Second Sex*. Translated by Constance Borde and Sheila Malovany-Chevallier. New York: Vintage Books, 2011.

Dennis, Flora and Jonathan Powell. "Futurism." *Grove Music Online*, 2003. https://doi.org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.10420.

Dennis, Flora. "Luigi Russolo." *Grove Music Online*, 2001. https://doi-org.proxy.lib.duke.edu/10.1093/gmo/9781561592630.article.24174.

Devine, Kyle. *Decomposed: The Political Ecology of Music*. Cambridge: MIT Press, 2019.

Gibbs, Kevin. "Insights on Blindness and Composing." Nmbx.newmusicusa.org. *New Music USA*, 2010. https://nmbx.newmusicusa.org/insights-on-blindness-and-composing/.

Greenhouse, Steven. "Bangladesh labor leader arrested during Rana Plaza protest in New Jersey." *The Guardian*, March 15th, 2015. https://www.theguardian.com/us-news/2015/mar/15/bangladesh-kalpona-akter-arrested-rana-plaza-new-jersey.

Hall, Sarah Lindenfeld (web editor). "NC Symphony's first sensory-friendly concert is this weekend." WRAL.com. Capitol Broadcasting Company, September 10, 2019. https://www.wral.com/nc-symphony-s-first-sensory-friendly-concert-is-this-weekend/18559967/.

Hartman, Kate. *Make: Wearable Electronics: Design, Prototype, and Wear Your Own Interactive Garments*. 1. ed. ed. Sebastopol: Maker Media, 2014.

Herschel-Shorland, Cassie. "Using Touch in Cultural Spaces." Access by Design (2015): 29-32.

hooks, bell. "The Oppositional Gaze: Black Female Spectators." In *Reel to Real : Race, Class and Sex at the Movies.* New York: Routledge, 2009.

Jensen, Joan M. and Sue Davidson. *A Needle, a Bobbin, a Strike : Women Needleworkers in America*. Philadelphia: Temple University Press, 1984.

Koons, Jeff. "Pre-New" JeffKoons.com. http://www.jeffkoons.com/artwork/pre-new.

Liang, Jiajie, Kwing Tong, and Qibing Pei. "A Water-Based Silver-Nanowire Screen-Print Ink for the Fabrication of Stretchable Conductors and

Wearable Thin-Film Transistors." Advanced Materials 28, no. 28 (2016): 5986-5996.

Lupton, Deborah. *The Quantified Self*. Malden, MA: Polity, 2016.

McCann, Jane and David Bryson. *Smart Clothes and Wearable Technology*. Cambridge: Woodhead Publishing, 2009.

McNicoll, Arion. "Isn't your tie a little loud? Sonic fabric, the textile woven from cassette tape." CNN, June 13, 2013. https://www.cnn.com/2013/06/13/tech/innovation/sonic-fabric-recycled-cassette-tape/index.html.

Misra, Joy, Mahala Dyer Stewart, and Marni Alyson Brown, eds. *Gendered Lives, Sexual Beings: A Feminist Anthology*. Los Angeles: Sage Publishing, 2018.

Morgan, Nigel, Alice Fox, Phil Legard, and Matthew Robinson. "Music and Textiles Interact." Craft Research 1, no. 1 (2010): 39-61.

Mulvey, Laura. "Visual Pleasure and Narrative Cinema." In *Feminism and Film Theory*, edited by Constance Penley. New York: Routledge, 1988.

Neff, Gina and Dawn Nafus. *Self-tracking*. Cambridge, Massachusetts: MIT Press, 2016.

Negri, Antonello. "Jannis Kounellis." *Grove Art Online*, 2003, https://doi-org.proxy.lib.duke.edu/10.1093/gao/9781884446054.article.T047778.

Noble, Tim and Sue Webster. "Artwerks." TimNobleandSueWebster.com. http://www.timnobleandsuewebster.com/artwerks.html.

Noguchi, Tamao, Kazue Onuki, and Osamu Arakawa. "Tetrodotoxin Poisoning Due to Pufferfish and Gastropods, and Their Intoxication Mechanism." *ISRN Toxicology* (2011). doi: 10.5402/2011/276939.

Page, Tom. "Embedded Electronics in Textiles and Wearable Technology." I-Manager's Journal on Embedded Systems 3, no. 4 (2014): 1.

Pailes-Friedman, Rebeccah. *Smart Textiles for Designers: Inventing the Future of Fabrics*. London: Laurence King Publishing, 2016.

Palmer, Brian. "Depending on how you listen, CDs may be the environmentally sensitive choice." WashingtonPost.com. *The Washington Post*. May 27,

2013. https://www.washingtonpost.com/national/health-science/depending-on-how-you-listen-cds-may-be-the-environmentally-sensitive-choice/2013/05/24/9a6ff63c-c15e-11e2-bfdb-3886a561c1ff_story.html.

Ploeger, Daniël. "Making and Breaking: Electronic Waste Recycling as Methodology." In *Digital Bodies*. London: Palgrave McMillan, 2017.

Rosalsky, Greg. "Are Plastic Bag Bans Garbage?" NPR.org. April 9, 2019. https://www.npr.org/sections/money/2019/04/09/711181385/are-plastic-bag-bans-garbage.

Russolo, Luigi. *The Art of Noise*. Translated by Robert Filliou. Ubu.com: Ubu Classics, 2004. http://www.artype.de/Sammlung/pdf/russolo_noise.pdf. Originally published in 1967.

Ryan, Susan Elizabeth. *Garments of Paradise: Wearable Discourse in the Digital Age*. Cambridge, Massachusetts: The MIT Press, 2014.

Santoro, Alyce. "Return to SOURCE: Contemporary Composers Discuss the Sociopolitical Implications of Their Work." Leonardo Music Journal 25 (2015): 100-101. https://muse.jhu.edu/.

Santoro, Alyce. "Sonic Fabric Flags, Jon Fishman." Paddle 8, 2015. https://paddle8.com/work/alyce-santoro/74591-sonic-fabric-flags-jon-fishman.

Santoro, Alyce. "Information." AlyceSantoro.com. http://www.alycesantoro.com/information.html

Scanlan, John. *On Garbage*. Chicago: University of Chicago Press, 2005.

Schniederman, Deborah and Alexa Griffith Winton. *Textile Technology and Design: From Interior Space to Outer Space*. London and New York: Bloomsbury Academic, 2016.

Seymour, Sabine. *Fashioning Technology: The Intersection of Design, Fashion, Science, and Technology*. New York: Springer Publishing Company, 2008.

Seymour, Sabine. *Functional Aesthetics: Visions in Fashionable Technology*. New York: Springer Publishing Company, 2011.

Silverman, Kaja. "Fragments of a Fashionable Discourse." In *On Fashion*, edited by Sheri Benstock and Suzanne Ferriss. New Jersey: Rutgers University Press, 1994.

Schneegass, Stefan and Oliver Amft. *Smart Textiles: Fundamentals, Design, and Interaction.* New York: Springer Publishing Company, 2017.

"State Plastic and Paper Bag Legislation." NCSL.org. National Conference of State Legislatures. January 24, 2020. https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx.

Suzuki, Yuri. YuriSuzuki.com. Accessed April 11th, 2020.

Tao, X.M., Xiaoming Tao and Textile Institute. *Wearable Electronics and Photonics*. Boca Raton: CRC Press, 2005.

Taruskin, Richard and Christopher H. Gibbs, *Oxford History of Western Music.* New York: Oxford University Press, 2013.

"The California Transparency in Supply Chains Act." State of California Department of Justice. https://oag.ca.gov/SB657.

Tincuta, Heinzel. "Haptic and Sound Correlations in Textiles." Conference paper from Proceedings of Ambience, 2014. Tampere, Finland. https://www.academia.edu/10747466/HAPTIC_AND_SOUND_CORRELATIONS_IN_TEXTILES

Tomico, Oscar and Danielle Wilde. "Soft, Embodied, Situated & Connected: Enriching Interactions with Soft Wearables." mUX: The Journal of Mobile User Experience 5, no. 1 (2016): 1-17.

Umbers, Kate D.L. "Deimatic Displays," *Current Biology* 25, no 2 (2015): R58-R59.

Wei, Zeng, Shu Lin, Li Qiao, Chen Song, Wang Fei, and Tao Xiao-Ming. "Fiber-Based Wearable Electronics: A Review of Materials, Fabrication, Devices, and Applications." *Advanced Materials* 26, no. 31 (2014): 5310-5336. doi:10.1002/adma.201400633. https://doi-org.proxy.lib.duke.edu/10.1002/adma.201400633.

Wissinger, Elizabeth. "Wearable Tech, Bodies, and Gender." *Sociology Compass* 11, no. 11 (2017): n/a.

Wright, Adam. "Hussein Chalayan: One Hundred and Eleven." Adam-Wright.com.

Wolf, Naomi. *The Beauty Myth: How Images of Beauty Are Used Against Women.* New York: HarperCollins, 2002.

Woodward, Sophie. *Why Women Wear What They Wear*. Oxford, New York: 2007.

Yang, Tingting, Dan Xie, Zhihong Li, and Hongwei Zhu. "Recent Advances in Wearable Tactile Sensors: Materials, Sensing Mechanisms, and Device Performance." Materials Science & Engineering R 115, (2017): 1-37.