On gender in new music interface technology*

GEORG ESSL

Computer & Information Science & Engineering, Room E301, CSE Building, P.O. Box 116120, University of Florida, Gainesville, FL 32611–6120, USA
E-mail: gessl@cise.ufl.edu

Gender is a category that is mostly unexplored in the field of new music interface technology. This paper explores some aspects of gender within the field. First, it studies the academic literature of the last five years with regard to the gender of the participants and the gender awareness of its content. Men are found to outnumber women in the field. The inspection of the literature shows a marked absence of documented gender awareness in the field. Then, the paper explores gender in new music interface technology performances of the last five years: two by male and two by female performers. It is discussed how they individually and in their cross-relationship speak to gender constructions. The analysis suggests that female performances seem to speak to gender issues whereas male performances seem to show an absence of gender as category. Finally, a further device is contrasted with these performances. I suggest that this technology is of particular interest for the artistic exploration of gender by making the body the recipient of performance.

1. INTRODUCTION

In this paper, I would like to talk about gender in the field of new interfaces for musical expression. People invent, design, build and use devices for musical performance. These people, as well as the audience witnessing the performance, are gendered subjects. However, the interrelation between the gender of participants and the technology and artistic performance within the field has so far been mostly unexplored. In the light of certain theoretical ideas put forward in gender and queer theory, this field seems particularly suitable for exploration of differences of gender construction.

In particular I will explore this question in three ways. First, I will discuss examples of recent theoretical writing in the field to explore whether or not it is possible to see gender awareness in it. Then, I will explore the awareness and function of gender in four contemporary performances using music interface technology. Finally, I want to suggest how new music interface technology may contribute to the theoretical and artistic work regarding gender.

The remainder of this paper has the following structure. First, I will introduce the categories that are relevant for this discussion and point to related literature. Then, I would like to discuss the current state of awareness of gender in the field as a whole as can be observed by examining the literature. Then, I will describe the development and relationship of four musical interfaces and their possible relationship with respect to gender constructions. Finally, I would like to describe one particular recent musical interface, which may be seen as offering additional potential for investigating gender.

2. BACKGROUND AND RELATED WORK

In this section I will discuss some categories that are relevant for this paper. In particular, the title introduces a number of concepts which deserve explanation. These concepts are new music interface technology and gender. New music interface technology refers to an academic field that is concerned with using technology for musical performance.

Music interface technology has a long-standing history. Music technology itself is even older, as any mechanical device that generates musical sound can be seen as music technology. However, music interface technology usually involves electrical components. Music interface technology of this type has emerged slowly since 1759 when Jean-Baptiste de La Borde built the Clavecin Electrique (Chadabe 2000), though electronic musical instruments started developing more rapidly only in the twentieth century.

In this paper, I will limit the discussion to aspects of the last five years. In particular, the field of new interfaces for musical expression has found recent resurgence and has seen the creation of a regular conference (NIME) in 2001 and the creation of the Working Group on Interactive Systems and Instrument Design in Music by the International Computer Music Association and the Electronic Music Foundation. A discipline seems to be forming from strands of ongoing research and design practices over the past years. It has lead to extensive

*I would like to thank Tomie Hahn for reprints, friendly exchanges and pointers to literature. I would also like to thank Stacey Langwick who provided early pointers to literature on gender studies in engineering, which helped shape my thinking on the topic of this paper. Many thanks also go to two anonymous reviewers and the editors whose detailed input was invaluable for greatly improving the manuscript. I also appreciate the encouragement of Paul Fishwick.

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

foundational and theoretical publications (Bongers 2000, Buxton, Buchla, Chafe, Machover, Mathews, Moog, Risset, Sonami and Waisvisz 2000, Cadoz and Wanderley 2000, Iazzetta 2000, Tanaka 2000, Wessel and Wright 2001, Machover 2002). In the next section, I will consider a number of these publications for their relationship to gender.

The study of gender itself has a long and multifaceted history and I want to assume a post-structuralist analytical stance. Post-structuralism consists of an awareness that the choice and definition of categories can constitute a problematic structural imposition. Also, narratives formed from these categories are considered to be questionable. As language itself is categorical, this constitutes a paradoxical condition. Post-structural writing often assumes that the reader understands the multiplicity of possible meanings of language. Hence, writing in this school of thinking is often metaphorical and allows for multiple incongruent readings. Plays with words are also common, which often assume a function of suggesting the questionable nature of narratives.

As the functions and validity of all categories are questioned, so are the categories of gender and sex. This argument has been presented by Judith Butler in her book *Gender Trouble* (Butler 1990). Butler suggests that gender and sex are not categories, which exist before discourse, but rather are brought into being through repeated acts. They are 'performative'. The appearance that gender and sex are stable categories before discourse is not actual and can be made visible through choosing alternative performances of sex and gender. These acts are often subversive for the apparent conflict between the narratives that support the categories of gender and sex and actions that undermine them. This theoretical approach is very insightful when discussing performance as it relates to categorical thinking in general and gender in particular. I will return to this line of thinking when discussing art performance and performance technology.

The suspicion of narratives in post-structuralist thinking often relates to notions of the subject and universality. The claim that one particular description, one subjectivity, is representative of universal descriptions and of a 'universal' subject is seen as suspect. Implied and explicit assumptions of universality are questioned. Some theorists argue as to the function of universals. Who can pose them? Who is marginalised or not expressed in them? What multiple forms of expressions are simplified into a singular category?

In this paper, I will attempt to use traditional forms of writing while at the same time maintaining a post-structuralist awareness of inherent complexities. In particular, I want to maintain a certain resistance to narrative formation. This will be expressed by a strong preference for description and a reluctance of claims of causative relationships when they are not immediately backed by the description. Any claims about perceptions of performances and readings of papers that are interpretive should be assumed to be the author's and not of a universal nature. Rather, the conclusion of a description may be a question which I will pose but leave unanswered, because the very possibility of posing a question constitutes the result and achievement of the descriptive observation. This line of writing is often misunderstood in academic settings where making a 'strong' point and giving a 'convincing' argument or answer is valued highly, and raising questions does not have an independent value beyond leading to answers. I beg the patience of the reader for writing that hopes to emphasise describing and questioning over interpreting and answering. Throughout this paper, I will refer to arguments that affirm categories as 'constructive' and acts that question categories as 'deconstructive'. In the light of the above outlook, I hope that my deconstructive intent for this paper will be understood.

Post-structuralist writing often emphasises difference. In the context of this paper, difference will be used when discussing related music technology performances. The function of difference is to show how the particular is in conflict with the assumptions of universal narratives. The idea is that particular instances may possibly be observed by comparison and focus on the differences. Language that imposes structure is often under scrutiny, and within structuring impositions, binary opposites have received the most attention. Binary categories like man/woman, composer/performer, nature/technology are questioned. If pairs of binary opposites assume a relational link, the structural validity of this link can be investigated by studying the variations of those pairings as they occur. For example, if the assumption is that man relates to technology and woman relates to nature, this assumption can be investigated by paying attention to the function of these categories in related narratives or performative acts.

The particular pairing of binary opposites of gender categories and categories of nature and technology lies at the core of the work of Donna Haraway (Haraway 1991). She suggests that placing technology in juxtaposition with something that is supposedly natural allows for questioning of the uniform 'naturalness' and relates to the complexities behind the category. Haraway symbolises this analytic juxtaposition in the image of a 'Cyborg', which she describes as 'a hybrid of machine and organism'. I will refer to Haraway's work and the Cyborg idea throughout the paper.

In general it is, however, desirable to go beyond simple pairings. Categories may be used in multiple contexts. For instance, female and male may have different contextual meanings in different socio-cultural settings. Also, the very choice of exactly two categories may be problematic. For example, the categories female and male may not be sufficient to discuss the category gender when transsexualism or transgenderism is to be included. Hence, the neglect of categories may impose

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

on or neglect groups or people who have not been taken properly into account. In this paper, I will respond to this awareness in two ways. First, I assume any description to be limited to the instances they describe and I am not making claims to generalisability beyond the individuals and their socio-cultural context. Second, I would like to propose that the richness of categorical intersections makes this field rich for investigation into the category of gender. The field of new music technology also brings together academic research, academic artistic performance, engineering and music communities. It hence provides an environment where many binary opposites meet. Some examples are man/woman, engineer/artist, nature/technology, composer/performer. This work is limited by the scope of the academic environment and related limitations to ethnicity and class. Within this limited scope, the field of new music technology provides an opportunity for the observation of the interaction of different conceptions of performance, creation, physicality, bodies, interactivity, communication and roles of the respective socio-cultural norms as they relate to gender.

Gender has been previously studied in related fields of intersecting contexts. For example, the role of gender has been studied in relationship to technology (Wajcman 1991), engineering (Forsythe 1993a, b, Downey 1998, Faulkner 2001), music composition, music performance, and music teaching. Some aspects of this cross-section have previously been studied. For instance, the gender aspects of technology have received attention. These studies illustrate the perpetuation of structures of power through technology and the maintenance and dissolution of stereotypes regarding gender and technology (Wajcman 1991). Also, the culture in which technology is created and the beliefs within this culture have been studied (Forsythe 1993a, b, Downey 1998, Faulkner 2001).

Music – and here I refer to academic or experimental music – has also received attention in recent years. Particular attention has been given to the study of gendered roles, expectations, possibilities and differences for musicians (Spiegel 1981, McClary 1991, Citron 1993, Sayrs 1993/1994, Macarthur and Poynton 1999, Hisama 2001, Dibben 2002, McClary 2002, Macarthur 2002, O'Neill 2002). This, then, is also intersected with the technology aspect in the study of computer music compositions (McCartney 1995, Simoni 1995, 1998, Dusman 2000, McCartney 2000, 2002). Gendered roles of composer and vocalist and voice in the electroacoustic community are explored (Bosma 1995, 1996, 1997, Eliot-Kahn 1998, Bosma 2000). Additional work is concerned with developmental aspects of gendered music culture (Harrison and O'Neill 2002, O'Neill, Ivaldi and Fox 2002), the role of music education (Green 1997, 2002), music technology education (Pegley 2000) and the exploration of alternative forms of education (Sayrs 1996, McCartney 2002). Gender is found to be a factor in musical performance and instrument choice (Boulton and O'Neill 1996, Harrison and O'Neill 2002). Gender in music is also studied ethnographically across cultures and regions (Koskoff 1987, Moisala and Diamond 2000).

Media artists repeatedly address gender issues. An example would be Laurie Anderson's work that definitely has important relationships to the interplay between technology, performance, music and gender. This has already been extensively explored (Birringer 1991, McClary 1991, Auslander 1992, Alexander 1997, do Nascimento Gonçalves 2001, for example). However, in the community of interest, Laurie Anderson's work does not seem to receive this kind of discourse. Her work is mentioned and credited, but the gender deconstruction of her work through technology is not visibly discussed (Paradiso 1997).

The performative and bodily have been recognised as having an important relationship to gender (Butler 1990) and the bodily and technological have led to feminist analysis (Haraway 1991), analysis in dance performance (Bartosik 2000), and new music analysis (Cusick 1999, Dusman 2000, McCartney 2000) and has informed artistic performance (Bahn, Hahn and Trueman 2001).

3. GENDER DISCOURSE IN NEW MUSIC INTERFACE TECHNOLOGY

What is the observable number of men and women participating in the community of new music interface technology? To investigate this question beyond subjective observation I will use the authorship of men and women of two recent internationally organised academic conferences in the field. These conferences were the first conference for New Interfaces for Musical Expression (NIME) in 2001 and the second NIME conference in 2002. The gender of the author was identified, if possible, by their first name or other auxiliary information. This identification is blind regarding cases where traditional binary gender definitions are problematic, like ambiguous gender identities, transsexualism or transgenderism. The author is unaware of the presence of any such complication in the described population. Simple counter-stereotypical naming, that is the use of a stereotypical female first name for males and vice versa was not observed. In the proceedings of the first NIME conference in 2001, fourteen publications and twenty-seven authorships can be counted, all of which were by men. At the second NIME conference in 2002 – a conference with a larger scope – out of a total of forty-three publications, forty-two had male involvement and twelve had female involvement. The total number of authorships is ninety-four. Seventy-nine authors are men and fifteen are women. In a comparison of shared and single-sex authored papers, thirteen papers had a single male author and one paper had a single female author. Collaborative efforts of just men led to eighteen papers.

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

There were no collaborative all-female papers. Eleven papers had joint authorships between women and men. Overall, many more men than women participate in the new music interface technology community. This can also be observed in the gender of participants of a 'round table' publication discussing electronic controllers in music performance and composition. It had eight men and one woman invited to participate, all being highly recognised contributors to the field (Buxton *et al*. 2000).

What is the perceptible state of gender discourse in the field? What is the range of gender awareness that can be documented? Because the field is right now in a state when much attention is being paid to defining the field's important topics, goals and challenges, I would like to try to base discussion of these questions on the documented discourse in this area. The proceedings of the first NIME conference and a recent edited volume (Wanderley and Battier 2000) contain a rich set of papers of this foundational nature. In particular, I would like to consider Bongers 2000, Fels 2000, Iazzetta 2000 and Tanaka 2000. These texts have specific commonalities. They are from the community that participates in NIME, which forms an intersection of musicians, engineers and cognitive psychologists, yet shows no visible involvement of social psychologists, sociologists, ethnographers, critical or gender theorists. All these references are by male authors. My discussion is intended to be descriptive and is not intended as interpretation of intent of the authors.

Fernando Iazzetta discusses meaning in music gesture (Iazzetta 2000). Specifically, he theorises the interplay between listening, gesture, body, performance and mapping, and the problem of how to associate gestures with sounds. His body is, however, ungendered, even largely impersonal. Context is only very briefly indicated twice. He writes, 'To say that the signification of a gesture operates by means of similarity, causality or convention means that the gesture is more characteristic of one of these three types but still can be related to the other two, specifically when the same gesture is present in a different context' (Iazzetta 2000: 262) and 'These *conventional* gestures do not necessarily keep any relation of similarity nor causality but they are constructed, shaped by external factors such as culture and language. They acquire signification by an abstract and functional process and learned to be shared by a specific group' (Iazzetta 2000: 263). The second reference is followed by a brief example of cross-cultural difference of gesture to illustrate the shift of meaning with context. While both of these suggest further discussion of the function of context, whether it be gender, performance setting, class, race or other groupings, this does not happen. Neither performer nor audience receives a sort of personhood or individuality that would more likely lead to a diversified discussion of their experience.

Atau Tanaka (Tanaka 2000) discusses performance practice on new musical interfaces. The paper presents the author's experience with various sensors but puts them into a theoretical context with an emphasis on the definition and function of an instrument. He theorises limits that are imposed by the technology itself. He also investigates how new instrument design interplays with composition and improvisation. Discussion of relationship focuses on the interaction of performer and instrument. Intimacy finds its definition as 'the feel' of the instrument and ability of the performer on the instrument. He writes, 'Ultimately, this produces virtuosi who combine unparalleled technical proficiency and expressive charisma on their instrument' (Tanaka 2000: 399). 'The intuitive sense the performer has with his instrument [. . .]' (Tanaka 2000: 400) is seen as critical for communication with the audience. When Tanaka discusses communication, he treats groups, like performer or audience, as unified and singular. Pluralism and diversification is not a visible part of the discourse. Tanaka sees technology as external and with a sense of independent conversant personhood. He writes, 'Rather, my goal has been to seek an organic interaction with the machine, to establish a conversational exchange with the instrument' (Tanaka 2000: 402). Even body-attached and body-sensory instruments do not create a discussion of body-extension, which would then suggest relation to modification and deconstruction of body boundary as captured by the Cyborg idea (Haraway 1991). In general, the focus of the paper remains with technology, and gender discourse is absent.

Bert Bongers (Bongers 2000) discusses two aspects of new music interface design: The 'human factor point of view' or ergonomics and sensory technology. The human is the performer. Bongers highlights the tension created by technology driving the performer and he claims, 'It became possible to develop alternative MIDI-controllers, which could be entirely new forms based on humans rather than on the technology' (Bongers 2000: 42). He also points out that interfaces can be seen as external or as part of the body. Performer, technology (which he calls 'system') and audience are singular and additionally symmetric. This symmetry is expressed when he describes that all three of them have interactive input, output and, what he labels 'memory & cognition'. This 'memory & cognition' is not diversified between individuals, neither does it cross the boundary of human self and a 'self' of technology. It is suggestive of a personhood of technology or alternatively of a mechanistic view of the self. This resembles somewhat the Cyborg idea (Haraway 1991). This is particularly interesting because pluralism introduced to these singular selves can, in this depiction cross over to technology and suggests a way of theorising the gender of interface technology. However, Bongers' paper does not display an awareness of this connection. Individual or social context (Muller, Wharton, McIver and Laux 1997) remains unmentioned. The second half of the paper discusses sensor technology, which again starts with a symmetric

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

dual taxonomy of sensors. The first is, as I would call it, techno-centric. The sensors are classified by the technological function based on mechanical measures. The second classification is based on 'human output modalities'. Interestingly, Bongers classifies 'smell' as 'physical energy quantity' (Bongers 2000: 51). This has to do with this classification dichotomy strictly seeing the human as performer and the technology as performed and hence the generative modalities of the human and the receptive modalities of technology are of interest. Bongers does not discuss the inverse, though it is suggested by the symmetric treatment of technology and body earlier in the paper. Under the human output modalities, the voice is listed along with muscle action, blowing, bioelectricity, temperature, blood pressure and heart rate. All of these might suggest differences between individuals and in addition may suggest differences according to groups including gender. However, this possibility is not realised. Reference to relevant discourses regarding voice and gender does not appear (see Bosma 2000, for example).

Sidney Fels (Fels 2000) discusses intimacy and embodiment in new art technology. In particular, he focuses on the relationship between a person and an object in an art installation setting. He classifies the possible relationships between object and person into four groups: the person either communicating with or embodying the object or – the symmetric inverse –the object communicating with or embodying the person. When he talks about communication, he means an interaction between a technological object and a person. His notion of embodiment closely resembles the idea of the Cyborg (Haraway 1991) when he writes, 'In this situation the person embodies the object. That is, they have integrated the object and its behaviors into their own sense of self. The object becomes part of them' (Fels 2000: 14). However, the person remains ungendered and singular, as does the object that otherwise appears symmetric. Through the symmetric inverse, a sort of deconstruction of the control of person on object is, intentionally or not, visible. According to Fels, when the object communicates with the person, a negation of existence of the person happens. Fels writes, 'From its perspective the person does not necessarily exist' (Fels 2000: 14). Though Fels treats the object with a sort of personhood through the symmetric construction, the object's perception is negated and it is brought back to the person who fills the cognitive void through 'reflection and contemplation'. Hence, the assumed symmetry really leads to asymmetry between object and person by solely placing cognitive functions on the person. Particularly interesting is Fels' discussion of the object embodying the person when he writes '[. . .] the person derives an aesthetic feeling through relinquishing control of themselves so that the object can manipulate them. The emotional response arrives through submission and belonging' (Fels 2000: 14). Not only is the site of control removed from the person, but it is also tied to an emotional response, which is assumed aesthetic. Fels does not relate control and power in any way. In addition, the emotional response is not explicitly diversified across individuals and the possibility of complexities are mentioned but not explained. Fels discusses intimacy as being the cause for the ability to 'communicate ideas and emotions efficiently through the device as if it were an extension of themselves' (Fels 2000: 14). This kind of intimacy, I read as meaning familiarity, automaticity (i.e. the ability to act without conscious effort; Bargh 1992) and controllability. In fact, it appears that the focus lies with skill and manipulability connected with a disappearance of the machine rather than with attachment to it. Overall, Fels does not address gender, and emotional categories appear to be singular.

There is only one publication in this community that I am aware of which explicitly discusses gender with respect to new music interface technology. It is by Curtis Bahn, Tomie Hahn and Dan Trueman (Bahn *et al*. 2001). I will discuss this publication in the context of three other works in the next section. Regardless, the theoretical work in new music interface technology in recent years is almost exclusively ungendered. If personhood is present it is predominantly singular and apparently unified if not universal. This writing rarely elaborates on context in a social or cross-cultural sense. At the same time, discussions of categories that are relevant in theoretical discourse of gender are visible, like embodiment and intimacy.

4. THE GENDERED/UNGENDERED AND CONSTRUCTIVE/DECONSTRUCTIVE: 'THE HANDS', 'LADY'S GLOVE' AND *PIKAPIKA, TIBET*

In the following, I would like to describe four lines of artistic work in the field along with some related discourse and suggest relationships between these works. These works are *con fus ion* by Michel Waisvisz using his controller called 'The hands' (Waisvisz 2002), *Why – dreams like a loose engine (autoportrait)* by Laetitia Sonami and Melody Sumner Carnahan using Sonami's controller 'Lady's Glove' (Sonami 1997, 2002), *Pikapika* by Tomie Hahn and Curtis Bahn using the 'SSpeaPer' performed by Hahn (Bahn and Hahn 2001), and *Tibet* by Atau Tanaka using EMG and relative position sensing technology (Tanaka 2002, Tanaka and Knapp 2002). I have seen these instruments/performer/performances live recently with the exception of *Pikapika*, which I only know through online video (Bahn and Hahn 2001). Waisvisz' *con fus ion* was performed at NIME 2002, as was Tanaka's *Tibet*. Laetitia Sonami came to visit Princeton to perform and explain her controller in 2000 (Sonami 1997, for a video demonstration). In this paper I will, however, refer to

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

the performance of *Why – dreams like a loose engine (autoportrait)* containing prose by Melody Sumner Carnahan, which I know from an online video source (Sonami 2000).

To study these new music technology performances I will discuss aspects of the technology as it relates to gender, including how the performers themselves talk or write about the controller. I will also compare the different technologies and performances to illustrate how the pieces are related concerning gender. Note that some chosen titles for interfaces or performance pieces are gendered. 'Lady's glove' makes explicit reference to gender as does *Pikapika* which is a Japanese female name. All other titles are ungendered.

The hand-controllers 'The hands' and 'Lady's glove' have related histories (Bongers 2000). Both are hand controllers initially designed by their performers and successively improved at STEIM, a centre for electro-instrumental music in the Netherlands. The performance is hand driven. The controller senses finger gestures to initiate sound generation. 'The hands' is a device that is external to the hand except for a loop that holds the controller in place. Sensors in reach of the fingers can be used to trigger sounds. The 'Lady's glove' is a glove that has been altered by attaching and embedding a number of electronic sensors into it. The performer's hand is fully inside the glove and literally internal to it. In this very simple sense these two controllers are already very different in appearance. The respective gestural use of the controllers also shows differences. Waisvisz plays a pair of 'the hands' with both hands almost at shoulder height and with the hands reaching forward. The performance gestures consist of often abrupt sideways motions of the arms and the torso. The range of motion of performance gesture of the 'Lady's glove' is wider, including subtle finger and arm movement combined with an arm range from low to shoulder-high to sideways; abrupt motions are also performed, but more scarcely. The accompanying sound abruptness but also the noise and spectral densities show similar differences. The sounds in *con fus ion* are often rough and mechanical, whereas the sounds played by Sonami were usually lighter and less suggestive of mechanical associations. These observations might tempt conclusions about stereotypes of 'Male = mechanical/loud/abrupt/aggressive' and 'Female = non-mechanical/soft/smooth/passive'. This is too simple and does not describe the performances well. *con fus ion* is a collaborative piece between Waisvisz and a male singer and the piece is not a display of mechanics and aggression. This sense can be extracted from the programme note written by Waisvisz to describe the piece (Waisvisz 2002):

> 'con fus ion' grew out of the desire to develop a sonic language not connected with roots, nationalism or other dividing ideas, neither was superficial fusion a desirable goal – we wanted to remain two individuals working together while being what we are: dangerously different and at the same time excited and aroused by the other's qualities and sometimes very congruent with each other. [. . .] we couldn't but discover it is nerve-wracking to navigate musically in a world that has so much high level information technology at its disposal and especially one so bent on misinforming people. Our art intentionally adds conflicting information to this silicon labyrinth: musically, culturally and contextually. By applying the philosophy of information-overflow we joyfully dissect the state of the art: a clash of lyrical tradition with 'electronica' and melt these dissections into our freshly created mutant audio-language and thus, we present you with our own meticulously nurtured 'con fus ion'.

In the performance, the singer is in contrast, conflict and confused with the technological and mechanistic display around him. The singer's articulations are broken and tentative as opposed to the dominant and imposing quality of the technology performing at the same time. I perceived the piece to convey this tension well. Tension of conflict over similarities and differences as described by Waisvisz definitely resembles the discourse of post-structural gender theory (Butler 1990), but the category gender seems unquestioned. Both 'lyrical tradition' and 'electronica' are performed in unison rather than in conflict with canon, tradition and gender stereotype. For example, 'electronica' is mechanistic and loud, whereas it could be non-mechanistic and soft. This is what relating this performance to Laetitia Sonami's performance of the 'Lady's glove' indicates.

Sonami expresses her view of the gender of the 'Lady's glove' in an interview with Phoebe Legere (Legere 2000):

> **Legere:** [. . .] You have made it somehow even female [. . .]
> **Sonami:** It is. It was a little the idea. There was [sic] several reasons but one of the reasons is definitely to have a sensual device. [. . .] Some of the controls that came out in the late 80s were this very robotic masculine 'let's fight the war' kind of controllers. So I thought mine would be a French sexy controller.

The performance too is a collaborative effort, though the other contributor has no bodily presence at the performance. Rather she is present through the lyrics. The prose describes a woman travelling on a train and taking perspectives of or observing other passengers. The performance consists of hand and body motion, event and ambient sound connected to it and spoken narrative, all performed by Sonami. This is an example passage of the lyrics transcribed from the performance (Sonami 2000):

> [. . .] or you're running all the time from your persistent and consumptive interest. Shoes particularly interest you at this time. They seem to signal upcoming reversals in attitude, the direction of weather, symbolism, a decline, or simply an obsession with what is natural, physical and known. [. . .] The men on this train have beards. Their beards match the colour of their pubic hair and their eyes. They worry about cars. They replace and distribute slips of

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

> paper. They punch and punch and punch holes in fallible objects and throw them to the ground. [. . .]

The theme is gendered and speaks to gender stereotypes and gender conflicts. Though again the performative does not seem to cross the boundary of the stereotypical. The stereotypical feminine is addressed but maintained, as is the stereotypical male. Associations of, for example, mechanical to male and natural to female seem persistent. However, a shift has happened between the Waisvisz performance and the Sonami performance. Gender is explicit in the latter whereas the former seems ungendered. This may be deliberate, unaware, or a performative of an assumed universal 'male' subject that does not require gender definition; see Butler (1990: 15) for a discussion of Luce Irigaray and Simone de Beauvoir on this point.

The performances *Pikapika* and *Tibet* use technology that could be classified as 'body-controller' interfaces. I am not aware of any shared history or even if the artists are aware of each other's work. Both pieces speak to an Asian identity. *Pikapika* is a performance by Tomie Hahn in collaboration with Curtis Bahn (Bahn *et al*. 2001). It is a performance piece that combines dance, interactive computer music, and video installations. Tomie Hahn's personification of *Pikapika* makes various visual references to anime and manga aesthetics. Manga and anime are Japanese comics or cartoon animation forms. In addition to the artificial hair colour and glossy body suit, sensors are connected to her limbs and a bulky backpack filled with visible technology is strapped to her back. The sensors trigger predominantly loud mechanical sound and the video projected in the background makes reference to manga, noise and information overload. The dance motions are inspired by traditional Japanese dance derived from puppet theatre.

The design and incorporation of the technology already displays an artistic intention regarding gender and other supposedly binary categories. The tension between hiding and displaying as well as actual as opposed to make-believe technology is very much part of the performance and affects decisions (Bahn *et al*. 2001):

> While desiring to capture these refined movements, it was important not to obscure or encumber the grace and beauty of her fingers with a glove or other device. A simple approach was chosen where the palm of each hand conceals a bi-axial accelerometer in a small box. [. . .] Adding to her 'high-tech' look, a clear plexiglass box housed in a leather backpack was created to reveal flashing lights and seemingly complex circuitry. Back speakers [. . .] are overtly wired and strapped on her back and arms to blatantly display technology.

This is but one of many apparently conflicting dichotomies that are addressed. Traditional japanese puppet theatre dance is combined with a modern technological dance/sound performance that makes reference to contemporary popular anime culture. The tension of the performed female is conflicting in the set-up of traditional female image undercurrents combined with a pop-female that is assertive, powered and empowered, yet suggesting the remainder of the puppet. Categories are not pulled apart but presented at once with a clear questioning of the underlying assumptions that constitute these categories. This is not only my subjective impression of the performance (Bahn and Hahn 2001) but also the intent of the artists (Bahn *et al*. 2001):

> In performance, theory fuses with practice through embodied acts, collapsing established dualities of composer/performer, musician/dancer, and researcher/participant. Pikapika breaks down numerous other dualities: self/other, male/female, machine/body, culture/nature and Hahn's own East/West biracial identity.

The piece is gendered and gender-deconstructive exactly because it is not gender alone. What is the connection of self to male/female, of machine to culture/nature, of body to researcher/participant? The piece raises all of these questions at once because the structural separation of categories can no longer be presupposed. *Pikapika* is a Cyborg, not a puppet, not a cartoon, not a woman, and not constructive and deconstructive. The she is visibly extended by and in control of technology yet is a person, she moves like a puppet but out of her own volition, she appears artificial and stylised yet disrupts the façade, and it seems apparent but at the same time ambiguous what of this display constitutes the woman.

Bahn, Hahn and Trueman also offer an alternative perspective on hand-control. They write (Bahn *et al*. 2001):

> [. . .] delicate motions of the hand often 'tell the story' of a piece. While desiring to capture these refined movements, it was important not to obscure or encumber the grace and beauty of her fingers with a glove or other device. A simple approach was chosen where the palm of each hand conceals a bi-axial accelerometer in a small box. Mounted on the outside of each box is a force-sensitive-resistor (FSR) which can be touched or squeezed discreetly to communicate with the computer.

The technology questions and reaffirms the hand as a site for control. Control is 'concealed' or at least 'discreet'. This is in contrast to the 'hand'-controllers of Waisvisz and Sonami that only affirm the hand as site of control by making it explicitly visible. Also in contrast is the collaborative effort, which in this case crosses the traditional gender categories. This is important to note, because the piece itself questions the composer/performer duality and gender roles that have been discussed in other contexts (Bosma 2000). *Pikapika* stands as a rare contemporary example in the new music interface technology community in addressing gender as a complex category following current gender theory (Butler 1990).

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

However, the fact that attention to body-sensors does not necessarily lead to gender-aware and gender-deconstructive performance can be seen from the work of Atau Tanaka and his piece *Tibet* (Tanaka and Knapp 2002). The piece combines physical instruments and electronic interface technology to create music. The physical instruments are Tibetan singing bowls made of glass of various sizes. Tanaka performs these bowls by either striking or rubbing around their rim with a wooden stick. The technology is visible as black ribbons around his arms above and below the elbow and wires leading towards the floor from each. Hand gestures create sound events, which merge with the sound created by the traditional performance of the bowls.

Tanaka, too, worries about notions of appearance of technology. He writes (Tanaka and Knapp 2002):

> The interfaces should provide modes of interaction that are intuitive to allow the performer to articulate his musical intention (control) at the same time allow him to 'let go'. [. . .] Making sense of the gesture–sound interaction is a first requirement for achieving musical satisfaction. However, at some moment, the audience also must be free to 'let go' and have the possibility to forget the technical underpinnings of the action at hand and to appreciate the musical situation at a holistic level.

Hence, technology does explore some opposites. Tanaka is also interested in other opposites when he describes *Tibet:* 'The piece Tibet explores the interstitial spaces between acoustic sound and electronic sound, between movement and tension, between contact and telepathy. Multiple, complimentary modes of interaction are called upon to explore these spaces. Physical contact elicits acoustical sound' (Tanaka and Knapp 2002). In contrast to Hahn, these are not conflicting, but as Tanaka puts it, 'a notion of *bidirectional complementarity*'. *Tibet* makes reference to Asian culture by utilising Tibetan singing bowls. The combination with Western performance culture and technology seems complementary rather than oppositional. The interaction between performer, technology and audience is seen as unproblematic as long as participants can 'let go' – a notion that remains vague. The category gender is again not visibly part of this piece. This work is interesting concerning gender when compared to Hahn's piece. There is a difference in perception of the function of oppositions. Tanaka perceives complementarities, synergy and clarity whereas Hahn displays conflict, tension and ambiguity. Another observable difference can be extracted from the sonic experience of the piece *Tibet* in relationship to *Pikapika* and the hand-controller pieces. I subjectively experienced *Tibet* to be a very serene piece. The Tibetan singing bowls ring gently when struck or ring in pleasant tones when rubbed. Smooth humming sounds are mapped to the electronic gesture interface. His motions are continuous. The performance seems to match the described sense of harmony and synergistic attitude that Tanaka describes. In a comparison between Waisvisz's and Sonami's performance, Waisvisz associated technology with loudness, mechanics and aggression whereas Sonami's technology was less so. In contrast, Hahn's *Pikapika* is sonically loud, mechanical and aggressive, whereas Tanaka's *Tibet* is quiet, non-mechanical and non-aggressive. Hence, the juxtaposition of these four performances seems to speak to a deconstruction of causal link between gender, technology and aggression.

In looking at all of the described performances, a number of questions arise: Are new music technology performances by women more likely to be gendered, gender aware, gender critical, or gender deconstructive? If so, why are they? Why, then, are performances by men rather comparatively ungendered, gender unaware, or uncritical?

5. INTIMATE OR INTIMIDATING: HOW DOES IT FEEL WHEN THE CYBORG TOUCHES YOU?

The relationship between body, gender and sex plays an important role in contemporary gender theory, particularly in Judith Butler's work. She asks, 'Is ''the body'' or ''the sexed body'' the firm foundation on which gender and systems of compulsory sexuality operate? Or is ''the body'' itself shaped by political forces with strategic interests in keeping that body bounded and constituted by the markers of sex?' (Butler 1990: 164). She follows with:

> The sex/gender distinction and the category of sex appears to presuppose a generalization of 'the body' that pre-exists the acquisition of its sexed significance. This 'body' often appears to be a passive medium that is signified by an inscription from a cultural source figured as 'external' to that body. Any theory of the culturally constructed body, however, ought to question 'the body' as a construct of suspect generality when it is figured as passive and prior to discourse.

Hence, she argues that there is a certain generalised passivity ascribed to the body, which allows for making it the receptor of cultural sexing and gendering. She questions the passive general permanence of the category 'body'. Donna Haraway argues, 'Cyborg imagery can suggest a way out of the maze of dualisms in which we have explained our bodies and our tools to ourselves' (Haraway 1991: 181). Haraway places Cyborg technology in a dualistic relationship to the supposed 'natural' and argues that the attempt of coding technology as natural leads to 'a realization that subverts naturalistic coding' (Haraway 1991: 162). Her arguments respond to the repeated formation of narratives that make claims that certain categories describe the 'natural'. To paraphrase Haraway's concern in Butler's language (Butler 1990: 164): Any theory of the culturally constructed 'natural' ought to question 'the natural' as a construct of suspect generality.

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

Can we find new music technology that uses Haraway's idea of subversion of the 'natural' by introducing the supposed 'technological'? At the same time, can this technology follow and investigate Butler's questioning of 'the body' as a passive medium of inscription of cultural meaning? I would like to suggest a recently proposed technology to have this particular possibility. This work is called *Cutaneous Grooves* (Gunther, Davenport and O'Modhrain 2002). Vibrotactile transducers are placed inside a full-body suit. Vibrotactile transducers are finger-size devices designed to create vibrations on skin in the low audible range of around 250 Hz. The devices are distributed across various spots of the body. They write, 'First, it was decided early on to distribute the transducers across the entire surface of the body. This decision was motivated by the analogy of a dancer, whose compositional tool is essentially the entire body' (Gunther *et al*. 2002).

Hence, Gunther and co-workers indeed propose that the entire body becomes the site for compositional activity. The body is inscribed by tactile composition. This technology, therefore, shows an inversion compared to the technologies described in the previous section. While previously the technology was a passive respondent to the performer, now the technology becomes active, and engages in touch, engages with the bodily. The body is the site of reception in addition to being the site for control, expression and performance. What happens in this particular reversal? Haraway's Cyborg becomes sensed and sensible. Technology now shows a way of exaggerating the body as a supposedly passive medium while at the same time defining, controlling, subverting and analysing the cultural, technological source that is external or internal to the body. By having the Cyborg touch the body, a number of questions are asked at the same time. Is the body in this technological performance 'passive'? Who forms the discourse of 'the body' in this context? Is the site of this formation external or internal to the body? Is the performative inscription an act of definition, of control or of subversion of a discursive norm? What of the performative inscription can be described?

These questions are relevant to the discourse in the community. In particular, the current discussion relates to Sidney Fels' notion of an object embodying a person, as described earlier. Apparently, the Cyborg controlling the body has this embodiment. Fels considers this a 'submission' and argues a presumed link to the notions of aesthetics, feeling and belonging. His implied generality of the categories 'aesthetics', 'feeling', and 'belonging' become questioned. The unity and universality of 'How does it feel?' across subjects is broken. The individual audience member may or may not state or answer this question. Sensation becomes plural and individual. 'It feels' and 'I feel' become separated and unified, asking for the body and for the identity of the Cyborg. What constitutes the difference between the two? Is 'it feels' external to the body? Is 'I feel' internal to the body? Finally, in the presence of the individual subjects, the question arises: Are their individual bodies gendered? Who gets to make this determination? How?

The Cyborg, then, crosses the boundary not only between gendered/ungendered but also, as Butler theorised, between sexed/unsexed and sex/gender. Is 'the body' in this performance technology discursively gendered or sexed? Or is the body left ungendered or sexless? Is a gendered person maintained sexless? Is a sexed person assumed ungendered? In particular, this technology addresses the relationship between touchable/untouchable and intimacy/intimidation. If the body is touched does this also mean that the 'untouchable' aspects of the cultural construction of the body are touched? Who is to evaluate whether this act is intimate or intimidating? Is it subversive to consider these possibilities? The impossibility of these questions or of certain answers may just be the signification for social-ordering taboos that were 'touched', which in turn relates to the cultural construction of gender.

This relationship is anticipated in Butler's post-structural interpretation of Mary Douglas's suggestion that (Butler 1990: 166):

> [. . .] the very contours of 'the body' are established through markings that seek to establish specific codes of cultural coherence. Any discourse that establishes the boundaries of the body serves the purpose of instating and naturalizing certain taboos regarding the appropriate limits, postures, and modes of exchange that define what it is that constitutes bodies [. . .]

Butler reads Douglas's body discourse as imminently relevant to imposed social order. She writes (Butler 1990: 167):

> Her analysis [. . .] provides a possible point of departure for understanding the relationship by which social taboos institute and maintain the boundaries of the body as such. Her analysis suggests that what constitutes the limit of the body is never merely material, but that the surface, the skin, is systematically signified by taboos and anticipated transgressions [. . .]

The taboo is the unspeakable, absent, invisible. Hence, Butler brings gender discourse towards the social ordering of discourse itself. Butler finds in Foucault's description of the appropriation of the body through power this tight link when she writes, 'The figure of the interior soul understood as "within" the body is signified through its inscription *on* the body, even though its primary mode of signification is through its very absence, its potent invisibility' (Butler 1990: 172, italics from the original). The moment of transgression shows the invisible. Hence, if the use of the technology is perceived as transgression, then the taboo has been reached. Silence may be indicative of the unspeakable.

However, it should be noted that Eric Gunther, Glorianna Davenport and Sile O'Modhrain (Gunther *et*

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

al. 2002) do not discuss gender aspects relating to their work. They discuss sensations and affective responses created by the technology in a specific and confined sense. For them sensation is 'multi-modal'. They note regarding stimuli generation, 'These pieces also explored the interrelationship between the musical and tactile components'. This idea was explored as part of a first concert by the designers of the technology. I was not present at this concert but witnessed demos of the device at NIME 2002. They write (Gunther *et al*. 2002): 'During September 2001, a series of concerts was held to introduce tactile composition to the greater MIT community as well as to test the technology and hypotheses presented in this paper. The concert was as much an experiment as it was an artistic event. A space was set up at the MIT Media Lab in which ten audience members at a time, each equipped with their own full-body vibrotactile stimulator, experienced a one hour concert of music and tactile compositions'.

They describe, 'Several audience members noted that at certain instances it actually felt as if the tactile stimulations were making them move. One audience member who was a drummer claimed that it gave him a sensation similar to that of playing the drums; where different body parts are rhythmically moving in an orthogonal fashion'. The affect is only noted in connection between musical and tactile components when they write, 'As a testament to affective interactions between the two mediums, one audience member reported that if the music was calm and soothing, then the tactile patterns felt even more so, whereas if the music was dissonant or jarring, the tactile patterns made him feel on edge, almost uncomfortable' (Gunther *et al*. 2002). They note, 'A detailed analysis of the affective response to tactile composition is premature and beyond the scope of this paper' (Gunther *et al*. 2002). Therefore, the modes they refer to when discussing sensation as multi-modal are tactile, musical hearing and movement. A broader consideration of affective response by the authors is still pending.

Is this ungendered description confirmation of Butler's theoretical argument? Does this technology touch a boundary but stay only on one side of it? What does this mean for gender? For Butler this boundary is at the very core of the social ordering of gender, which directly leads her to the core of performativity as central to her analysis. She writes (Butler 1990: 173, italics from the original):

> In other words, acts, gestures, and desire produce the effect of an internal core or substance, but produce this *on the surface* of the body, through the play of signifying absences that suggest, but never reveal, the organizing principle of identity as a cause. Such acts, gestures, enactments, generally construed, are *performative* in the sense that the essence or identity that they otherwise purport to express are *fabrications* manufactured and sustained through corporal signs and other discursive means. That the gendered body is performative suggests that it has no ontological status apart from the various acts which constitute its reality.

As gender does not exist prior to the acts that constitute it, acts can reconstitute what gender means. Butler calls this notion 'subversive bodily acts' (Butler 1990). It is subversive because these acts go counter to the allowed, social-ordering acts and undermine its prohibitions.

I am suggesting that *Cutaneous Grooves* offers the possibility of implementing and exploring this very notion. What of an actual inscription on the body will break its generalised identity and reveal its organising principle, as Butler suggests? What of an inscription on the body is speakable? Can the unrevealable be revealed? The technologies of the previous section consider the role of the body in only one way: the body is that of the actor. These questions become possible, because the technological performance of *Cutaneous Grooves* draws the role of the body itself into consideration. It changes the meaning of the 'bodily act.'

6. CONCLUSIONS

In this paper, two aspects of gender in the academic field of new music interface technology were discussed. One was the current amount of gender awareness and gender focus as can be extracted from publications in the fields between 1997 and 2002. This study reveals that the participation in the field displays a gender imbalance and that gender itself is practically absent from the academic discourse in the community of new music technology interface researchers.

The second was the gender awareness in artistic performance and the potential of technology to address gender issues. I first explored and contrasted four different interfaces, connected performances, and their respective and differential relationships to gender issues. The performances were discussed in conjunction with writings or other forms of expressions of the artists to facilitate an analysis regarding gender awareness and gender construction. Gender awareness can be found in both pieces by female performers whereas such awareness is, in the particular pieces discussed, absent from male performers. The comparison between the pieces also reveals additional complexities. For instance, the ways gender themes are approached are very different between the two female performers.

I then contrasted these performances with another type of new music interface technology. This technology inverts the role of the body. Instead of being the site of control and performance, it becomes the site of reception and audience. This technology illustrates how new music technology can further contribute to gender discourse through this inversion for it addresses the relationships between body, gender and sex. These relationships have become an important domain of exploration

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

in post-structural gender and queer theory (Butler 1990). The performative of gender takes an important role in these theories. Through the new technology, following earlier suggestion by Donna Haraway that technology allows analysing gender constructions (Haraway 1991), new artistic inquiries into the function of the body in these relationships and the role of the performative in the theory become possible. 'The body' is augmented, extended and questioned as well as delimited, confined and affirmed through this technology. 'The body' becomes the performer of gender but also the audience of gender.

REFERENCES

Alexander, K. 1997. Ladies and gentlemen, androgyns and cyborgs: disembodied narratives in Laurie Anderson's *Home of the Brave* (abstract only). In *Abstracts of Feminist Theory and Music* **4**. Charlottesville, VA. http://www.people.virginia.edu/~smp8a/Abstracts/sess32.html

Auslander, P. 1992. *Presence and Resistance: Postmodernism and Cultural Politics in Contemporary American Performance*. Ann Arbor: University of Michigan Press.

Bahn, C., and Hahn, T. 2001. *Pikapika*. http://www.arts.rpi.edu/crb/Activities/SSpeaPer/pikapika.htm.

Bahn, C., Hahn, T., and Trueman, D. 2001. Physicality and feedback: a focus on the body in the performance of electronic music. In *Proc. of the Int. Computer Music Conf. (ICMC-01)*. Havana, Cuba.

Bargh, J. A. 1992. The ecology of automaticity: toward establishing the conditions needed to produce automatic processing effects. *American Journal of Psychology* **105**: 181–99.

Bartosik, K. 2000. Technogenderbody. *Body, Space + Technology* **1**(2). http://www.brunel.ac.uk/depts/pfa/bstjournal/1no1/journal1no2.htm

Birringer, J. 1991. *Theatre, Theory, Postmodernism*. Bloomington and Indianapolis: Indiana University Press.

Bongers, B. 2000. Physical interfaces in the electronic arts. In M. M. Wanderley and M. Battier (eds.) *Trends in Gestural Control of Music*, pp. 41–70. Paris, France: IRCAM.

Bosma, H. 1995. Male and female voices in computer music. In *Proc. of the Int. Computer Music Conf. (ICMC-95)*, pp. 139–42. Banff, Canada.

Bosma, H. 1996. Female authorial voices in electrovocal music. In *Proc. of the Int. Computer Music Conf. (ICMC-96)*. Hong Kong.

Bosma, H. 1997. Écriture féminine in electrovocal music. In *Proc. of the Feminist Theory and Music 4 Conf.* Charlottesville, VA.

Bosma, H. 2000. Who creates electro-vocal music? (author, composer, vocalists and gender). In *Ctrl+Shift Art – Ctrl+Shift Gender*. Netherlands: Axis.

Boulton, M. J., and O'Neill, S. A. 1996. Boys' and girls' preferences for musical instruments: A function of gender. *Psychology of Music* **24**(2): 171–83.

Butler, J. 1990. *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.

Buxton, W., Buchla, D., Chafe, C., Machover, T., Mathews, M., Moog, B., Risset, J.-C., Sonami, L., and Waisvisz, M. 2000. Round table: electronic controllers in music performance and composition. In M. M. Wanderley and M. Battier (eds.) *Trends in Gestural Control of Music*, pp. 415–38. Paris, France: IRCAM.

Cadoz, C., and Wanderley, M. M. 2000. Gesture – Music. In M. M. Wanderley and M. Battier (eds.) *Trends in Gestural Control of Music*, pp. 71–94. Paris, France: IRCAM.

Chadabe, J. 2000. The electronic century part I: Beginnings. *Electronic Musician*.

Citron, M. J. 1993. *Gender and the Musical Canon*. New York: Cambridge University Press.

Cusick, S. G. 1999. On musical performances of gender and sex. In E. Barkin and L. Hamessley (eds.) *Audible Traces: Gender, Identity, and Music*, pp. 25–48. Zurich: Carciofoli.

Dibben, N. 2002. Gender identity and music. In R. A. R. MacDonald, D. J. Hargreaves and D. Miell (eds.) *Musical Identities*, ch. 7, pp. 117–33. Oxford: Oxford University Press.

do Nascimento Gonçalves, F. 2001. Performing the trojan horse: Laurie Anderson's strategies of resistance and the 'postmedia era'. *Body, Space + Technology* **2**(2). http://www.brunel.ac.uk/depts/pfa/bstjournal/2no2/journal2no2.htm

Downey, G. L. 1998. *The Machine in Me: An Anthropologist Sits among Computer Engineers*. New York: Routledge.

Dusman, L. 2000. No bodies there: absence and presence in acoustmatic performance. In P. Moisala and B. Diamond (eds.) *Music and Gender*, ch. 14, pp. 336–45. University of Illinois Press.

Eliot-Kahn, K. 1998. Voice and speech in computer music composition. In *Proc. of the Int. Computer Music Conf. (ICMC-98)*, pp. 45–8. Ann Arbor, Michigan.

Faulkner, W. 2001. The technology question in feminism: a view from feminist technology studies. *Women's Studies International Forum* **24**(1): 79–95.

Fels, S. 2000. Intimacy and embodiment: implications for art and technology. In *Proc. of the ACM Multimedia 2000 Workshops*, pp. 13–16. Los Angeles, CA.

Forsythe, D. E. 1993a. Engineering knowledge: the construction of knowledge in artificial intelligence. *Social Studies of Science* **23**: 445–77.

Forsythe, D. E. 1993b. The construction of work in artificial intelligence. *Science, Technology & Human Values* **18**(4): 460–80.

Green, L. 1997. *Music, Gender, Education*. New York: Cambridge University Press.

Green, L. 2002. *Exposing the Gendered Discourse of Music Education. Feminism & Psychology* **12**(2): 137–44.

Gunther, E., Davenport, G., and O'Modhrain, S. 2002. Cutaneous grooves: composing for the sense of touch. In *Proc. of the 2002 Conf. on New Interfaces for Musical Expression (NIME'02)*. Dublin, Ireland.

Haraway, D. 1991. A cyborg manifesto: science, technology, and socialist-feminism in the late twentieth century. In D. Haraway (ed.) *Simians, Cyborgs and Women: The Reinvention of Nature*, pp. 149–81. New York: Routledge.

Harrison, A. C., and O'Neill, S. A. 2002. The development of children's gendered knowledge and preferences in music. *Feminism & Psychology* **12**(2): 145–52.

Hisama, E. M. 2001. *Gendering Musical Modernism*. New York: Cambridge University Press.

Iazzetta, F. 2000. Meaning in musical gesture. In M. M. Wanderley and M. Battier (eds.) *Trends in Gestural Control of Music*, pp. 259–68. Paris, France: IRCAM.

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press

Koskoff, E. (ed.) 1987. *Women and Music in Cross-Cultural Perspective*. Urbana: University of Illinois Press.

Legere, P. 2000. *Interview with Laetitia Sonami*. Originally aired on DCTV. Available as streaming video at http://radio.el.net:8080/ramgen/noisy/sonami_interview.smil

Macarthur, S. 2002. *Feminist Aesthetics in Music*. Westport, CT: Greenwood Press.

Macarthur, S., and Poynton, C. (eds.) 1999. *Musics and Feminisms*. Sidney: Australian Music Centre.

Machover, T. 2002. Instruments, interactivity, and inevitability. In *Proc. of the 2002 Conf. on New Interfaces for Musical Expression (NIME'02)*, p. 1. Dublin, Ireland.

McCartney, A. 1995. Whose playground, which games, and what rules? Women composers in the digital playground. In *Proc. of the Int. Computer Music Conf. (ICMC-95)*, pp. 553–60. Banff, Canada.

McCartney, A. 2000. Cyborg experiences: contradictions and tensions of technology, nature, and the body in Hildegard Westerkamp's 'Breathing room'. In P. Moisala and B. Diamond (eds.) *Music and Gender*, ch. 13, pp. 317–35. Urbana: University of Illinois Press.

McCartney, A. 2002. New games in the digital playground: women composers learning and teaching electroacoustic music. *Feminism & Psychology* **12**(2): 160–7.

McClary, S. 1991. *Feminine Endings: Music, Gender, and Sexuality*. Minneapolis, MN: University of Minnesota Press.

McClary, S. 2002. *Feminine Endings: Music, Gender, and Sexuality,* ch. 'Feminine Endings in Retrospect', pp. ix–xx. Minneapolis, MN: University of Minnesota Press, 2002 print edn.

Moisala, P., and Diamond, B. (eds.) 2000. *Music and Gender*. Urbana: University of Illinois Press.

Muller, M. J., Wharton, C., McIver Jr., W. J., and Laux, L. 1997. Toward an HCI research and practice agenda based on human needs and social responsibility. In *Proc. of CHI 97: Human Factors in Computing Systems*, pp. 155–61. Atlanta, GA: ACM.

O'Neill, S. A. 2002. Crossing the divide: feminist perspectives on gender and music. *Feminism & Psychology* **12**(2): 133–6.

O'Neill, S. A., Ivaldi, A., and Fox, C. 2002. Gendered discourses in musically 'talented' adolescent females' construction of self. *Feminism & Psychology* **12**(2): 153–9.

Paradiso, J. A. 1997. Electronic music: new ways to play. *IEEE Spectrum* **34**(12): 18–30.

Pegley, K. 2000. Gender, voice, and place: issues of negotiation in a 'technology in music program'. In P. Moisala and B. Diamond (eds.) *Music and Gender*, ch. 12, pp. 306–16. University of Illinois Press.

Sayrs, E. 1993/1994. Deconstructing McClary: narrative, feminine sexuality, and feminism in Susan McClarly's feminine endings. *College Music Symposium* **33**/**34**: 41–55.

Sayrs, E. 1996. *Feminist Pedagogy in Graduate Music Classes*. http://home1.gte.net/esayrs68/FemPed.html

Simoni, M. 1995. A survey of gender issues related to computer music and strategies for change. In *Proc. of the Int. Computer Music Conf. (ICMC-95)*, pp. 13–18. Banff, Canada.

Simoni, M. 1998. Profiles of determination. *Computer Music Journal* **22**(4): 19–28.

Sonami, L. 1997. *Lady's glove*. Online demonstration as part of Paradiso 1997. Available online at http://www.spectrum.ieee.org/select/1297/glove.html

Sonami, L. 2000. *Why – dreams like a loose engine (autoportrait)*. Originally aired on DCTV. Available as streaming video at http://www.noisy.org/ram/sonami.ram

Spiegel, L. 1981. Comments on common complaints. *EAR* **6**(3): 8.

Tanaka, A. 2000. Musical performance practice on sensor-based instruments. In M. M. Wanderley and M. Battier (eds.) *Trends in Gestural Control of Music*, pp. 389–405. Paris, France: IRCAM.

Tanaka, A. 2002. *Nime 02 – highlights from the talks, demos, and concerts*. http://www.mis.atr.co.jp/~mlyons/nime02.html

Tanaka, A., and Knapp, B. R. 2002. Multimodal interaction in music using the electromyogram and relative position sensing. In *Proc. of the 2002 Conf. on New Interfaces for Musical Expression (NIME'02)*, pp. 43–8. Dublin, Ireland.

Waisvisz, M. 2002. con fus ion. http://www.xs4all.nl/mwais/confusioninfo.html

Wajcman, J. 1991. *Feminism Contronts Technology*. University Park, PA: The Pennsylvania State University Press.

Wanderley, M. M., and Battier, M. (eds.) 2000. *Trends in Gestural Control of Music*. Paris, France: IRCAM.

Wessel, D., and Wright, M. 2001. Problems and prospects for intimate musical control of computers. In *Proc. of the CHI'01 Workshop New Interfaces for Musical Expression (NIME'01)*. Seattle, WA: SigCHI. http://www.csl.sony.co.jp/person/poup/research/chi2000wshp/papers/wessel.pdf

https://doi.org/10.1017/S1355771803001031 Published online by Cambridge University Press