The *hipdiskettes* : Learning (through) Wearables

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ABSTRACT
Physically engaging wearable interfaces offer a new means of self-expression. They help us move beyond our reliance on linguistics by supporting more open, dynamic and fluid forms of expression that are pre-verbal, that originate in the body. Our research suggests that they also present untapped potential for learning about how different people learn. We investigate this idea through the learning process of the *hipdiskettes*, a group of performers working with the *hipDisk* wearable musical interface. Examples from the initial rehearsal periods are presented, noting the learning affordances provided by the interface, learning supports provided by the developer, and the different needs and approaches over time of the performers. Investigating learning was not the focus of the *hipDisk* research yet outcomes suggest that a consideration of how different people learn through, and about, their bodies is beneficial to the development of physically engaging wearables.

Categories and Subject Descriptors
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Performance, Design, Experimentation, Human Factors.

Keywords
Wearable, Embodied Interaction, Physical Engagement, Kinaesthetics, Multi-modal Learning.

1. INTRODUCTION
The *hipdiskettes* are a group of performers who develop live performance using the *hipDisk* – a wearable interface that extends and augments the moving body with musical capabilities (Fig.1,3)[12][13]. This study documents the initial learning process of the *hipdiskettes* and interrogates how an understanding of individual learning preferences and tendencies might inform the development of wearable interfaces.

Learning is usually thought of in an educational context. We shift our consideration of learning to a more experiential and body-centric focus, considering how the performers learn through, and acquire knowledge about, their bodies while operating and moving towards mastery of the interface. Unlike non-wearable interactive interfaces and artefacts, wearables cannot be put down, moved through, or otherwise decoupled from the body. They provide a kind of body-artefact environment that must be navigated by the wearer through their physicality, especially when physical engagement is key. Learning is highly individual. Different people have different strengths and preferences for how to accrue, understand and retain information [4]. Learning of physically engaged and engaging wearables can be logical-mathematical, musical, spatial, bodily-kinaesthetic, interpersonal, intrapersonal, spatial, haptic, aural, etc. [4]. The task can be approached in a variety of ways, so provides an ideal opportunity to observe and cater to individual learning preferences and tendencies.

If developers better understand how different people learn through their bodies, and the opportunities this affords, we will be better placed to develop physically engaging wearables, more accessible and relevant to a wider range of individuals. The information could also inform the development of other physically engaging interactive artefacts and wearables.

OZCHI 2008, December 8-12, 2008, Cairns, QLD, Australia.

OZCHI 2008 Proceedings ISBN: 0-9803063-4-5

2. RELATED WORK
A description of *hipDisk,* is provided in 3.1. A comprehensive overview, including related work, is also available [12].

Levisohn argues that the body should be an integral element of interactive systems [7]. This cannot be ignored when developing wearable interfaces, which place us at the epicentre of experience. The phenomenologists put forth that the body is at the foundation of our existence in the world [5][8], an idea Dourish expands upon through his discussion of embodied interaction [3]. Physically engaging wearables draw focus to this idea as interaction is initiated, and engagement realised, through the body. Even when a wearable is used to trigger *distal* phenomena [10] the coupled nature of the interface to our body renders the experience immediate, *proximal* [10], or as Heidegger would say *ready-to-hand* [5][12].

In his theory of multiple intelligences, Gardner asserts that individuals have different preferences for learning [4]. This aligns with Heidegger's concept of *throwness* [5], and the idea that our *being-in-the-world* is coloured by our individual journeys and experiences, which affect not only experience but also engagement. How people approach tasks is affected by *throwness*. Our experience with the *hipdiskettes* supports this notion, while providing an opportunity to explore Rauscher et al.'s suggestion that musical and spatial intelligences draw on common abilities [11].

The intense physical effort required by *hipDisk* also reminds us of Mueller et al.'s exertion interfaces [9]. *hipDisk* generates much laughter and smiling on the part of the wearer [12]. The difficulty of the device also seems to encourage camaraderie and interpersonal engagement, or what Mueller et al. call social interaction.

Figure 1. The *hipDiskettes* investigate the spatial and choreographic potential of the *hipDisk*

3. THE HIPDISK

3.1 The interface and underlying rationale

The *hipDisk* extends the body horizontally at the hip and torso to augment the moving body with musical capabilities [12][13]. It exploits changing relationships between torso and hip to actuate simple tones. The horizontal extensions exaggerate, so make highly visible the interdependent relationship of the hip and torso. Soft switches, strategically placed around the perimeter of each disk, allow the wearer to play a one-octave chromatic scale, and so play simple melodies, one note at a time. *hipDisk* was designed to inspire people to swing their hips and explore and extend the full range of movement available to them through a simultaneous, interdependent exploration of sound. The objective was to move beyond limb and digit-triggered switches and explore full-body movement for actuation. The resulting body-instrument requires intense physical engagement and interconnects choreography and composition in a fundamental way. (Fig.1)

3.1.1 From solo to ensemble

A single *hipDisk*-ed performer can only play one note at a time. The formation of an ensemble of *hipDisk*-ed performers supports the generation of more complex musical output. A group of *hipDisk*-ed performers can collectively play chord structures, harmonize, provide counterpoint, and play a range of notes in rapid succession – so create rhythmically more complex works than a single *hipDisk*-ed performer alone. An ensemble is also better placed to explore the choreographic potential of the interface.

3.1.2 The hipdiskettes

A group of performers, with a range of musical and movement skills, were brought together to learn and create performance for the *hipDisk*. Their goal is to develop and perform a special arrangement of The Girl From Ipanema[1], a classic Bossa Nova tune that crosses cultural boundaries and resonates with the swimming costumes that *hipDisk*-ed performers wear.

4. LEARNING THE HIPDISK

Learning the *hipDisk* is a two-stage process. First, technical ability must be developed – the performers need to learn how the interface works, and be able to perform desired notes consistently and repeatably. Second, interpretive ability must be developed – the performers need to learn how to express themselves with the device, both through improvisation and by following a score. The arrangement of the Girl From Ipanema for four *hipDisks* combines technical ability with interpretive ability as the performers both improvise and perform a strict arrangement of the score that optimises their strengths, while leaving room for expressivity. It was thus used as the vehicle through which both stages of learning were approached.

4.1 Methodology

Rehearsals were scheduled three times a week for six consecutive weeks. Each session was 3-4 hours long: 30 minutes warm-up and cool down; 2 hours learning and playing; additional time, where necessary, for fittings and adjustments. The designer was present throughout, observing and taking notes. All sessions were videotaped for later review.

4.1.1 Fit and functionality

Transforming a wearable to fit a range of bodies can be challenging. In the case of *hipDisk*, the disks must be tightly coupled with the body and positioned where they will touch when the wearer bends at the waist. Each wearer must be fitted for individual shape, posture, movement tendencies and flexibility. For some wearers it is easy to hit the back notes, for others this is challenging as they lack lower back flexibility. Placement of disks can help to compensate. The centre of each disk also needs to be aligned with the centre of the body, rather than placed in relation to the external body shape, so finding the correct horizontal placement can be difficult. These adjustments draw focus to the wearer's body and movement capabilities, so provide valuable information to the developer.

In the case of *hipDisk*, the physical requirements of each of the *hipdiskettes* also shifted over time as they became more comfortable with the device and better able to understand and express what was happening for them. It also changed as they became better at playing the device, with improvements in core strength and flexibility. As a result fitting the *hipDisks* is an ongoing process affected by and affecting learning.

4.1.2 In-built affordances

Each disk has twelve points of contact, or switch-halves, spread around the perimeter, representing the twelve notes on a chromatic scale. Immediate and simple socio-cultural associations can be made between the number twelve and a circular formation such as the hours spread around a circular, analogue clock face and the 30° divisions on a protractor that inform, for example, the divisions of cakes, tarts and other circular forms. These common associations suggest that most people can easily distinguish a resolution of twelve switches.

The audio output also assists performers as it acts as an emphatic marker, indicating that the disks have touched, and, once the notes have been learnt, where they have touched. This facilitates recognition and repetition of correct body placement.

[1] by Antonio Carlos Jobim, arranged by the author.

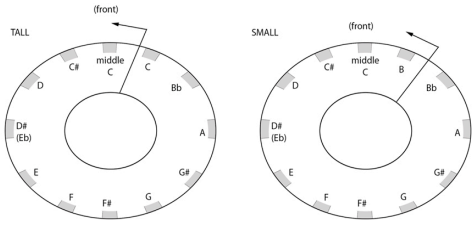

Figure 2. Disk mappings for *The Girl From Ipanema*

4.1.3 Additional supports provided

A number of additional learning supports were provided to help the performers locate the individual notes so they could play them with intention: they were given the musical score of The Girl From Ipanema; disk mappings – graphic representations of the disks with the note layout clearly marked for reference (Fig.2); and the names of the notes were marked on the interfaces next to each switch. Rehearsal sessions were also recorded and the camera fed directly into a studio monitor for simultaneous viewing and reviewing, so that actions and reactions could be observed and discussed.

4.2 Outcomes

In learning the device, the *hipdiskettes* adopted a number of different approaches (Fig. 3). They were variously seen changing direction in the space, for example, in order to better orient themselves; holding the score and disk mappings in their hands, placing them on the floor, or attaching them to the upper disks for ready reference. They worked alone and in pairs: working in unison, in complement, or with one person supporting the other's solo work. At times one performer would observe and provide oral feedback for the other, they would also use touch to give directional/positioning information. Essentially, they engaged in interpersonal and intrapersonal learning, they worked kinaesthetically, orally, aurally, visually and haptically. They were also emotively engaged in the learning process – exclaiming with delight, moaning with frustration, laughing with and cheering each other on.

4.2.1 Navigating the mapping process

The *hipDisk* employs the body in movement, requires spatial orientation and generates sonic output that can be used to verify body position and create music. When learning a tune one needs to map from notes on a page or other musical notation, to notes spread around the disks, to the body positions required to trigger the notes. This mapping is navigated conceptually, spatially and physically.

Some performers found the mapping easier than others. This impacted, and was evidenced by, their ability to get results. Some found it easy, for example, to commit note positions to body memory, others almost impossible, and this affected their ability to repeat and play notes with intentionality. Approaches also varied from one performer to another. They all experimented, taking cues and leadership off each other before choosing what worked best for them. And no matter their preferences, they all asked each other to verify at different times which notes they were hitting, especially at the back where it was difficult to see.

Sonic feedback is an essential component of the *hipDisk*. Yet at times the performers preferred listening to and focusing on their bodies and muscular positioning, with vocal support from one of the other performers. In this case, *Performer1 (P1)* would play, while *Performer2 (P2)* talked or sang the notes (by name, in key). When *P1* experienced difficulty the singing would become almost dirge-like, as *P2* tried to encourage them to hit the corresponding note, so create the tune. The vocal support seemed an almost tangible way to support the physicality of the struggling performers.

4.2.2 Interpersonal learning

The interpersonal nature of learning seemed important throughout. There was much camaraderie as the performers helped each other to succeed at what was often a difficult task, empathised with each other through the difficulties, and shared a sense of success when things went well.

4.2.3 Comparison of two performers

To gain further insight into different performer approaches, and the aforementioned affect of *throwness*, we contrast and compare the experience of two performers. They come from similar backgrounds, have a shared physical and performance vocabulary and have worked together on a number of occasions (Table.1). While a sample of two is not sufficient to make assertions, findings suggest further investigation is warranted.

Table 1. Performer learning and skill history comparison

Wearer 1	Wearer 2
Good lower back flexibility	Limited lower back movement
Tendency to move torso	Tendency to move hips
Familiar with musical notation	Cannot read music
Good sense of rhythm	Difficulty recognising and maintaining rhythms
Good aural recognition of notes (improves over time)	Limited aural recognition of notes (little improvement)
Interface fits with ease	Ongoing difficulties with fit and placement
Experienced movement practitioner	Highly experienced movement practitioner
Twenty years performance experience	Thirty years performance including aerial acrobatics
Five years theatre and movement teaching experience	Twenty years advanced movement teaching and analysis
Age: 35-45	Age: 45-55

In brief, *Wearer 1* had a basic understanding of musical notation and was able to map the notes from the score to the disk quite quickly. This facilitated her learning and playing of The Girl From Ipanema. She was also able to recognise notes aurally, so was not as reliant on visual feedback, so could integrate positioning for note sequences relatively quickly. In contrast, *Wearer 2* does not read music or recognise the sound of notes and has no understanding of a chromatic, or other scale. She is not familiar with musical naming terminology and had difficulty mapping the dots on the score to letters on the page to notes around the disk to sounds output by the *hipDisk*. Despite her advanced understanding of the body and its capacity for movement she experience ongoing difficulty committing positions and sequences to body memory. Of note is the fundamental difference in their relationship to music and musical notation. *Wearer 2* struggled sonically and spatially despite having vast expertise in movement and acrobatics, reminding us of Rauscher et al's notion that musical and spatial intelligences draw on common abilities [11].

Figure 3. Intrapersonal and interpersonal learning: working kinaesthetically, visually, vocally, aurally, spatially and haptically

5. CHALLENGES

The *hipDisk* interface, while technically simple, is a challenging interface to learn. Despite evidence to the contrary, the performers continually underestimate how long it will take them to master the device. The disparity between how simple the *hipDisk* appears and how difficult it is to learn has a significant impact on the learning process. Scheduling adequate development time is challenging, as is navigating performers' emotional responses to the difficulty of the task. Fortunately, the pleasure of making a note – any note, when playing the *hipDisk* is enormous, so despite at times not getting the desired results, making music – no matter how ungainly, has so far provided sufficient emotional reward to maintain commitment.

6. REFLECTIONS

Deeper analysis of existing footage of the *hipdiskettes* is needed to gain further insight into how the performers interacted with each other, and how they both collectively and individually made use of the different learning supports. The intention was to provide a scaffolding to support a range of access points so enable the different performers to undertake their learning in line with personal strengths, preferences and tendencies. It was an open acknowledgement that there are many ways that people learn, just as there are many ways to approach complex tasks such as learning to play the *hipDisk*. It is important to understand how effective the supports provided were, as well as how their usefulness was tempered by individual experience and knowledge. It is also important to acknowledge that the performers themselves are an integral part of each others' support systems, and that knowledge is passed between them both implicitly and explicitly.

People are complex. They think and learn in different ways. It seems logical that the broader the range of entry points for learning a physically engaging wearable, the greater the possibility a wearer has of individualising their learning process, so approaching the task in a way that suits them. If developers were better informed about this we could create diverse support structures to cater for a wider range of individual approaches, so make our work more accessible and relevant. We need to acknowledge the complexity of the people we are working with and for. Creating wearables is not about creating work for biomechanically complex coat-hangers. People are far more than their bodies alone.

7. FUTURE DIRECTIONS

The ongoing learning process of the *hipdiskettes* will continue to be observed and documented, and deeper analysis undertaken. The enquiry will be broadened by observing the learning of Helmer's Wearable Instrument Shirt [6] in a range of contexts. The aim is to deepen our understanding of how different strengths, tendencies and preferences in learning affects users' approaches to physically engaging wearables, and how we might structure and develop both the wearables and supports for their learning accordingly, so create work of greater relevance and accessibility.

8. ACKNOWLEDGMENTS

The first *hipDisk* prototype was created during Reskin [2], supported by an ANAT [1] Professional Development Grant. Thanks to Dr Richard Helmer and Dr Melissa Miles for their support. I would also like to acknowledge the performers for their commitment, curiosity, expertise and playfulness. Their hard work and patience makes this research possible.

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