Performance as digital text: Capturing signals and secret messages in a media-rich experience

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Abstract

As libraries increasingly undertake digitization projects, it behooves us to consider the collection/capture, organization, preservation, and dissemination of all forms of documentation, including and beyond written text. While several libraries have funded projects which acknowledge the need to digitize other forms of text, few have extended the digital projects to include film, much less performed texts. Further, as more performing arts incorporate born-digital elements, use digital tools to create media-rich performance experiences, and look to the possibility for digital preservation of the performance text, the capture of the performance event and its born-digital artefacts must be considered. This article, then, presents a first look at the ARTeFACT project, undertaken at the University of Virginia Library in collaboration with an introductory course in Engineering and a student choreographer at Brenau University Women's College. Historical intersections of technology and dance are introduced, theoretical concerns of using technology in dance are considered, the processes involved in the creation, capture, and preservation of dance data are discussed along with the technologies used to produce an interactive dance performance.

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Imagine you are watching a dance captured on video. On the screen you see four women, dressed in various shades of blue, moving singly, and in unison (Fig. 1). They dance on a stage bereft of props or backdrop, lit only by dim amber lights shining on them from low angles. Recorded music accompanies the movement and supports the mood of the piece, entitled *For Natalie*. It is a fairly basic work, as dance works go: pedestrian costumes, a few lights, music, dancers, and movement. And yet, it is hardly as straightforward as you may think (Adshead-Lansdale, 1999; Goellner, 1995). Aside from the fact that no dance is straightforward, in that the art of dance is inherently multi-layered by virtue of the artistic idea being transmitted through corporeal action in space, the 1-min film clip you watch demonstrates the added complexity of film. It is an edited form of the dance work, a short clip

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Fig. 1 A single video frame chosen from thousands to represent a 1-min video clip of the April 2008 performance of *For Natalie* (Stalnaker, 2008)

selected from a 15-min dance work captured by a single gaze, a static camera, placed in an arbitrary location, on an evening that suited our schedule. It does not show the process of creating the work, the choreographer's ideas, the inspiration and motivation for the work, her movement choices. In fact, there is much to say about the somewhat unusual choreographic processes involved in this work, as it was choreographed as part of ARTeFACT, a project developed to study the generation, preservation, and re-purposing of data gathered from dance movement.

For more than ten years those in the discipline of dance, and the performing arts, have discussed digital technologies and questioned their use to produce, 'preserve, and make accessible' dance artefacts (Nichols, 1997, p. 187). Indeed, several libraries have funded projects that acknowledge the need to document movement-based texts; however, as the following quotes and others demonstrate, many issues continue to exist as librarians, archivists, artists, and historians address the inclusion of digitized dance artefacts in library repositories and archives.

> Although digital technologies can incorporate filmic ways of perceiving [the performing arts], that is the tip of the iceberg. It is important for us to anticipate that there are other forms we can use for documentation rather than limiting ourselves to the tradition of a camera in front of the stage. Documentation within a digital environment far exceeds the filmic way of looking at a performance.
> Ashley 2005 quoted in NYPL Working Group 4, 5

> How can new technology both support the information we think is valuable, but also put it in a format that the next generation is going to understand and make use of?
> Mitoma 2005 quoted in NYPL Working Group 4, 6

As these quotes note, for the most part, the discourse centres around filmic means of digitizing and preserving dance; however, some researchers suggest that other tools can be used to preserve dance movement. One dance artist and scholar, Lisa Naugle, notes that motion capture techniques 'provide historical dance information; historical in that data are immediately available at the time movement is captured and can, therefore, be used later in different ways by different people, for reinterpretation' (Naugle, 2001, p. 76). Naugle's purpose, however, is not to preserve the data for posterity or for study, so much as it is to use the data to enable animation and virtual dance. Other researchers have posited that preserved motion capture data can facilitate further study of dance. In fact, the Dance Heritage Coalition included motion capture as a technique for documenting dance for historical and anthropological study (DHC, 2006). As valuable as motion capture can be, it considers only the movement and the personal kinesphere; there is no relation to external space per se nor to dynamics of the movement. Labanotation, a graphic depiction of dance movements and space which can be generated through a computer application, can offer a means of seeing individual bodies in relation to space, as it can describe the movement and directional space. So, too, does Laban's effort-shape analysis—eukinetics—describe dynamics. Yet as valuable as notation and motion capture are for providing some means of preserving dance movement, they cannot offer a complete picture of a dance, as neither takes into account the multiple elements that together constitute a dance.[1] Further, these methods discount entirely the preservation of born-digital elements created during an interactive performance.

Motion capture, however, is a method used *create* digital elements in dance works including interactive technologies. In fact, dance has long used technology in production, especially in the C20 within the modern dance world. Examples of this would be the work that Alwin Nikolias created through interactive technologies in the 1950s and 1960s (Nikolais commissioned the first commercial Moog synthesizer in 1964 for his dance company), the work developed in Denmark with Robert Wechsler and the Palindrome Dance Company using EKG transmissions and other technologies, and the motion capture work that Shelley Eshkar and Paul Kaiser performed with choreographers Merce Cunningham (designer of Life Forms choreographic software) and Bill T. Jones (multi-media choreographer), to name but a few. This is work that definitely has the 'cool' factor in performance. But again, how does one capture that production element among the many elements involved in the dance? How do we preserve it, and further, why? It is our hope that through the ARTeFACT project we can answer some—if not all—of these questions.

1 The Project

The ARTeFACT project is not above 'cool' as in its initial stages, the project was imagined as one of those production projects invoking the spirit of Nikolais, yet using newer technologies such as the Wii and a Mac, with the collaboration of a choreographer and a group of first year engineering students. In its first phase, ARTeFACT (project Alpha) included six teams of students in an Introductory Engineering Class, designed and taught by Professor Brad Bennett, Research Director at University of Virginia Kluge Institute. Each team was asked to design and build an orthotic device that, when worn, causes the wearer to emulate the challenges of walking with a physical disability.[2] During the course of the semester, the student teams captured pre-event processes in a variety of digital formats: still and video images of the prototypes from cameras and cell phones, PDF files, mathCAD drawings, PowerPoint files, and video documentation of their in-class presentations (Fig. 2). In lieu of a final exam, the students produced a performance during which members of each group wore their devices and moved through the space according to 'choreography' set by their peers.

Adding to the complexity, the performance drew on the wide variety of supporting, media rich, source material created during the course of the semester, as part of an interactive event. In addition to the previously mentioned student teams developing orthotic devices, two other teams were assigned the task of developing wireless measurement sensors which, when attached to each orthotic device, measured the impact of the device on the gait of the wearer. The sensors then transmitted the measurement data to a computer that fed the data into a software application, Max/MSP/Jitter, designed to take advantage of data streams. The software created real-time data visualization as output. The resultant audio visual montage played as the backdrop to their final production, *Walk Don't Run*.

When planning the project, several methods for transmitting data were considered: radio frequencies, wireless ethernet, infrared light, and Bluetooth. Bluetooth specifications met all of the design requirements for the project, and the students had immediate access to a variety of Bluetooth options, including Nintendo Wiimotes, a gaming interface, as well as the Newton Apple, a sophisticated, medical-grade, six-degrees-of-

Fig. 2 'Jiminy Rickets' design artefacts (Coartney and Wiesner, 2007)

freedom sensor for measuring movement developed by a local R&D company, Barron & Associates (see Fig. 3). While the Newton Apple was the more sophisticated and preferred device, the Nintendo Wiimotes offered the advantage of existing and proven connectivity.

Max/MSP/Jitter treats all data as a series of data-streams, with patches controlling the signals. The performance patch (Fig. 4) samples data streams from the Wiimotes and dynamically generates a video performance element. The critical components of the patch are (i)connecting and sampling the sensor data; (ii) randomly choosing source data to be processed; (iii) processing the source data to create a new 'real-time' performance element; (iv) outputting video to an external display; and (v) capturing and recording the sampled data streams and born-digital video to file.

DarwiinRemote, akawiiremote, and the Max application manage the connectivity into the computer.[3] The second function of the patch involves randomly selecting files based on the movements of the performers. As the performers' bodies shift, the signal spikes in response to the movement, and the spikes trigger the selection of videos and still image files.[4] The third operation of the performance patch transforms the content by manipulating the opacity, pixel order, and video playback rate; the sensor data controls the amount and frequency of these manipulations. The processed video is then sent out the video port on the computer for projection as the backdrop of the performance.

An example of these three operations can be seen in Fig. 5. The data, captured during a performance with the orthotic device created by the team studying Rickets, is presented as a graph (Fig. 5A) and requires no understanding or knowledge about its source or what it represents. It is necessary to isolate the blending function and deconstruct the performance in order to understand how the sensor placement as well as the x, y, and z data-streams impacted the blending effect in the visual backdrop. Visualizing the impact from numbers alone is challenging, especially when only subsets are used and

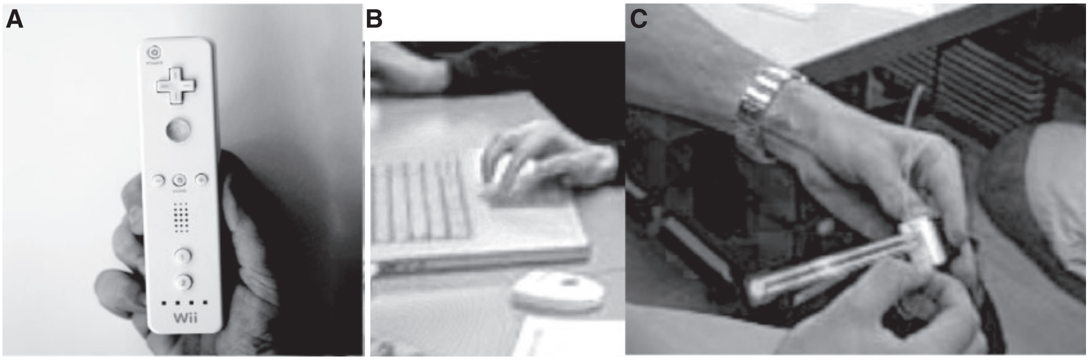

Fig. 3 Sensor technologies including (**A**) Nintendo Wiimote (Coartney and Wiesner), (**B**) Newton Apple (Coartney and Wiesner, 2007) and (**C**) force strip (Coartney and Wiesner, 2007)

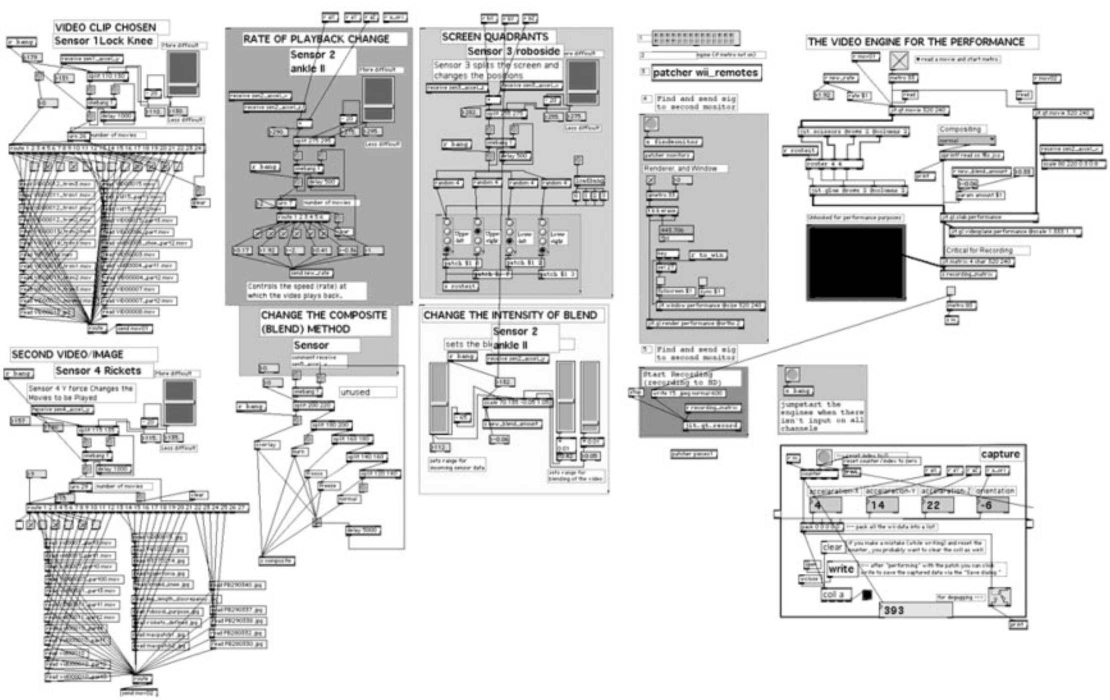

Fig. 4 A screen capture of the December 2007 *Walk Don't Run* performance patch used to dynamically generate the real time data visualization. Cycling74 Max/MSP Version 4.6.3, Jitter Version 1.6.3, Mac 0S X Version 10.4.x (Coartney and Wiesner, 2007)

these values normalized. Therefore, in order to represent the impact of changing values on the overall composition, the images shown in Fig. 5B–D display the results from three different blend values.

The final process, the capture and recording of the sensor data stream, sample rate, and video output, is not a necessary component of the performance, but it is integral to this project. It is the capture and preservation of the data that allows

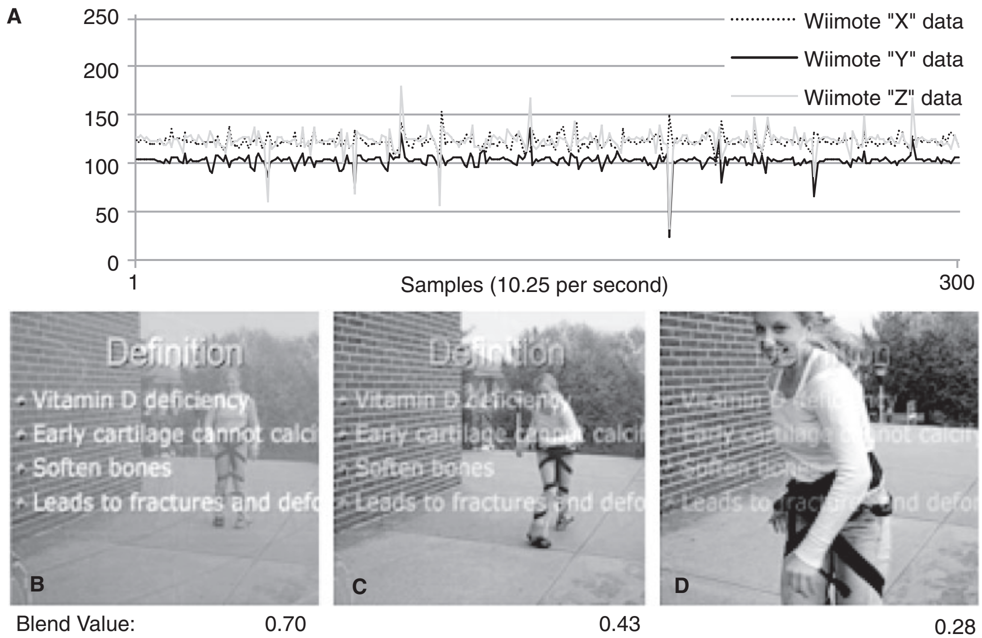

Fig. 5 The graph (**A**) plots the *x*, *y*, and *z* numeric values from the Wiimote as stored in the computer. Captured data samples range in value from 0 to 255 with a sample arte of once every 80 ms. Created by normalizing and processing the data from the Wiimote's '*y*' axis, individual video frames (**B**, **C**, **D**) demonstrate the blending of a still image and a video (Coartney and Wiesner, 2007; Bryant et al., 2007)

for the study, analysis, and recreation of the video as a performic element. Further, by sampling the data-streams and capturing performance data, we are able to analyse existing data for a particular performance, deconstruct/reconstruct original performic events, and create new ones.

Further, with a nod to Naugle, by making the artefacts accessible to artists we can enable creativity, which in turn further supports our research. For example, from ARTeFACT Alpha (*Walk Don't Run*) to ARTeFACT Beta (*For Natalie*) there was not only the creative stimulus for the choreographer, but also a unique example of movement patterns shared across works (Fig. 6A–C).[5] Further, collecting these artefacts allows us to problematize yet again the use of preservation mechanisms such as motion capture and labanotation in dance research, as the movement was so difficult to notate that the choreographer was reduced to capturing only a few steps, and resorted to developing her own system of signs and verbalization to describe the rest, a common method of describing dance, a method without a ubiquitous lexicon.[6]

As demonstrated by the images above, by capturing and preserving visual artefacts we are able to see the visible traces of the movement patterns. Further, as we move into the next phases of the project we will not only be able to use the choreographers' work against the data to see the true mechanics of the movement, we will also be able to see traces between movement and data. Thus, by making the preserved artefacts 'accessible' to researchers we are taking steps, however small, towards the future development of exploitable metadata, automatic pattern recognition, and even feature-based tagging of moving image.

2 Conclusion

The task of capturing and preserving a performance is challenging in and of itself without adding the

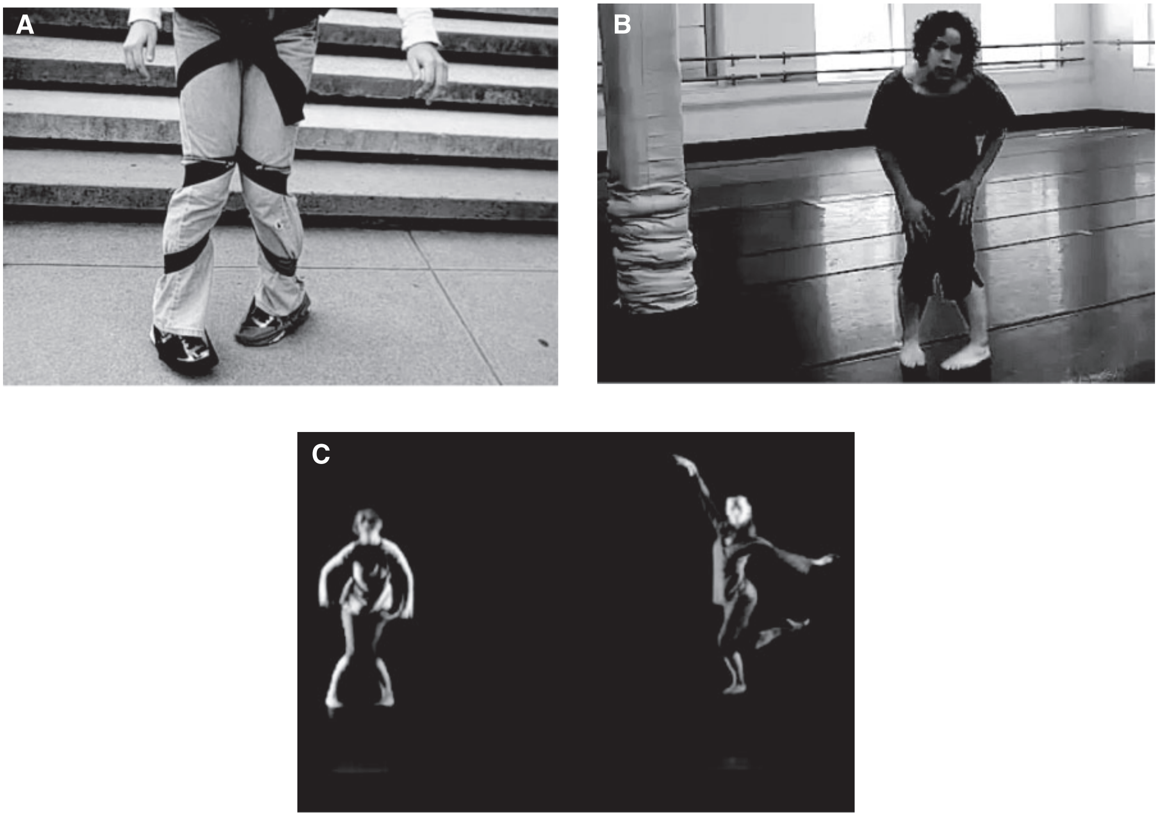

Fig. 6 The challenge of manoeuvring while wearing the orthotic device (Coartney and Wiesner, 2007) (**A**) are described by the choreographer (Coartney and Wiesner, 2007) (**B**) and translated into derivative movements performed in *For Natalie* (**C**)

complexity of performance elements that are created in real time. One might question the value of collecting and preserving artefacts for all elements surrounding a dance. Dance is, after all, ephemeral, and in fact, mo-cap guru Eshkar has stated, 'Of course you could reuse the files but why would you want to?' (quoted in Naugle, 2001, p. 77). So why bother preserving the various elements?

As technological advances continue, the rules and limits surrounding publication and distribution of knowledge will change and we perceive a future in which time-based media and the display of non-linear information will not be the challenge it is today (Kholief, 2003; Reichert, 2007). Access to filmed and online entertainment as well as console and online video games will impact scholarship and research in ways we can only imagine. Studying, understanding, and exploiting these new sets of tools will allow us to more fully integrate science, technology, and the arts and to capture the signals and begin to interpret the secret messages generated as part of this media-rich experience.

Notes

1 Neither can a written text give a comprehensive representation of a work, for as much as we in the discipline would like to believe that we focus on movement elements, research has shown that often do so only in an effort to substantiate our subjective realization of theme (Wiesner, 2007).

2 Movement disabilities included stroke-induced 'drop foot' and paralysis, Cerebral Palsy hypertonia, knock-

knees as a result of Rickets, leg-length discrepancy, and locked knee syndrome).

3 The Wiimote, a Bluetooth enabled device with built-in accelerometers and an optical sensor, synchronizes with the Macintosh using, DarwiinRemote, open source software found on the sourceforge website, www.sourceforge.net. A second piece of software, aka.wiiremote currently available at http://www.iamas.ac.jp/~aka/max/, is an external object built specifically for Max/MSP/Jitter by Masayuki Akmatsu and it feeds the Wiimote data stream into the performance software patch.

4 The source data for the performance consisted of fifty-one movie and still image files totalling 200 MB. The videos and still images were extrapolated from the project documentation that occurred throughout the semester. The resulting video, displayed as a backdrop during the production, was a dynamically generated visualization of the process of designing and creating the orthotic devices worn in the performance.

5 In addition to her study of the digital artefacts generated by the engineering class students, the choreographer used the devices themselves (actually wearing them to choreograph). This forced her to work within the limitations of the devices, inhibiting her level of abstraction, thus causing her to choose movement similar to those of the students, especially in the case of the Rickets device. Still, although closely associated with project Alpha (indeed, almost a derivative), according to the FRBR principles, *For Natalie* is not an expression, but a new 'work' replete with its own collection of artefacts, such as the choreographers notes, interviews with the choreographer, film of rehearsals and performance, programs, a research paper, movement analysis, and labanotation).

6 Admittedly, an experienced notator may be able to capture the movements; however, this level of expertise is difficult to obtain and, sadly, few notators of such expertise exist.

References

Adshead-Lansdale, J. (ed.) (1999). *Dancing Texts: Intertextuality and Interpretation*. London: Dance Books.

Bryant, D., Lenz, S., Manaktala, R., and Mason, K. (2007). *Jiminy Ricketts*. Still Images: Digital. Project collection (UVA).

Coartney, J. and Wiesner, S. (2007). *ARTeFACT*. Still Images: Digital. Project collection (UVA).

Dance Heritage and Coalition (2006). *Documenting Dance: A Practical Guide*. Washington, DC: Dance Heritage Coalition.

Goellner, E. W. and Murphy, J. S. (1995). *Bodies of the Text*. New Brunswick, NJ: Rutgers University Press.

Kholief, M., Maly, K., and Shen, S. (2003). *Event-based Retrieval from a Digital Library Containing Medical Streams, Proceedings of the 2003 Joint Conference on Digital Libraries* (Online). http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel5/8569/27127/01204867.pdf (accessed 31 March 2008).

Naugle, L. (2001). Reinterpreting choreography: motion capture data as historical information. In *Society of Dance History Scholars Proceedings 2001*, 24th Conference. Birmingham: SDHS.

New York Public Library for the Performing Arts, Jerome Robbins Dance Division (2005). Report from Working Group 4. *Dance Documentation Needs Analysis* Meeting 2.

Nichols, M. M. (1997). Art and artifact: the digital option, a case study of the 'Il Papa' manuscript. In *Society of Dance History Scholars Proceedings 1997*, 20th Conference. Birmingham: SDHS.

Reichert, L. (2007). Intelligent Library System Goes Live as Satellite Data Streams in Real-Time (Online). http://www.lockheedmartin.com/news/press_releases/2001/IntelligentLibrarySystemGoesLiveAsS.html (accessed 31 March 2008).

Stalnaker, R. (2008). *For Natalie*Video: DVD. Personal collection (slide).

Wiesner, S. L. (2007). *Framing Dance Writing: A Corpus Linguistics Approach*. Ph.D. thesis, University of Surrey, Guildford, Surrey.