Chapter 4

Research Methodology

In this chapter, the evolution and composition of the research methodology is described, including a rationale for the choice of research methods.

The research methodology is characterised by an open-ended investigation underpinned by principles of reflective practice (Schön, 1983) and an open and receptive stance to the data and phenomena (van Manen, 1997). In the spirit of reflective practice described by Schön (1983), the research work proceeds with a first move to answering the research questions. The results of this first move are then critically reflected upon in the light of the original research questions to determine the next move. An iterative cycle of action, reflection and revision or refinement drives the research work towards completion. Scrivener and Chapman (2004) outline a similar approach, characterised by reflective practice, recently developed for practice-based research in art and design, where a central component of the research is the making of a creative production.

A high-level schematic of the research design, presented in Figure 4.1, illustrates the role of reflective practice in the research methodology. Core research activities of literature review, data collection, data analysis and trialling of design methods/tools are interwoven with periods of reflection and subsequent revision or refinement of the various research activities and possibly the research questions themselves.
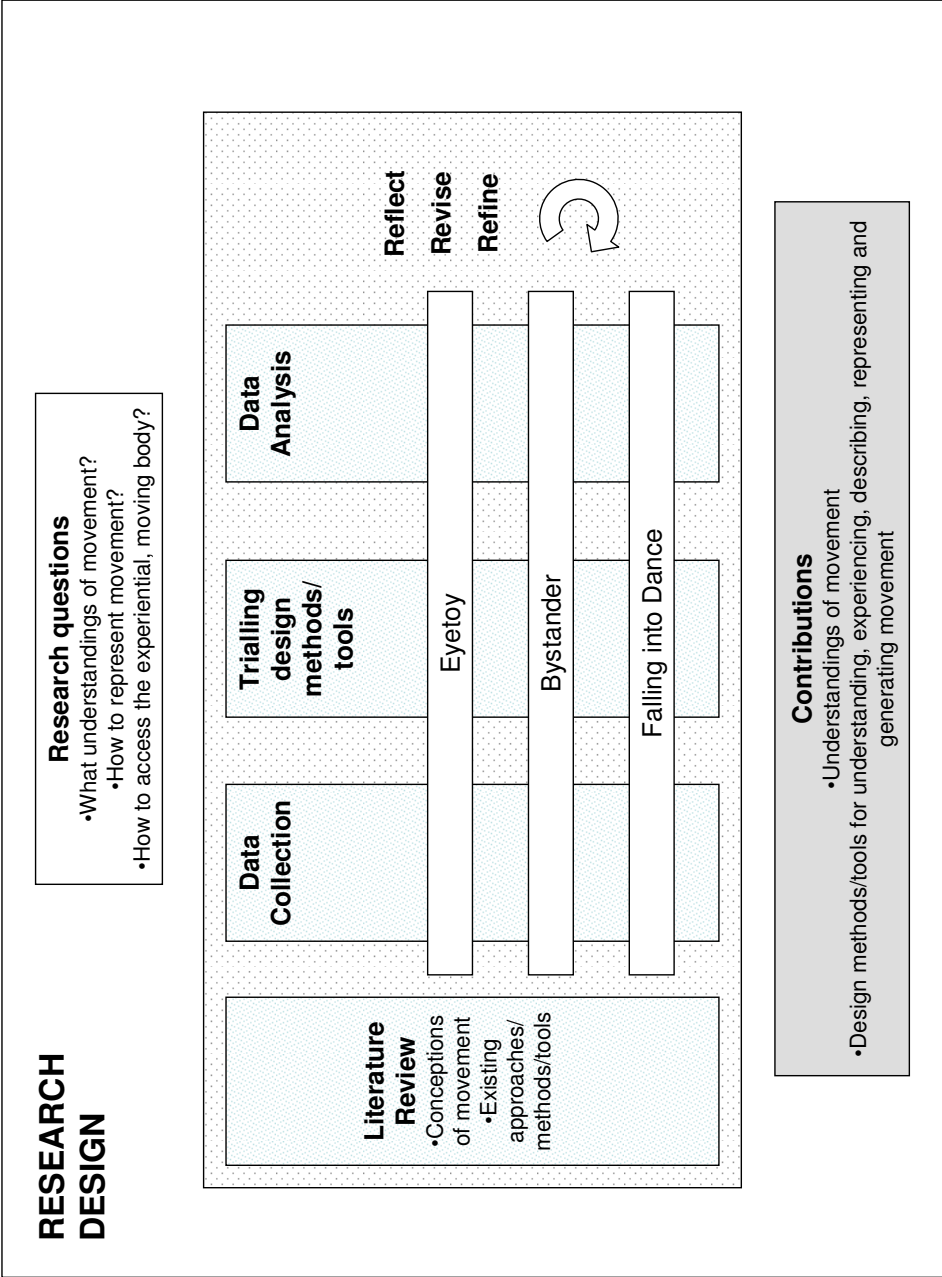
Figure 4.1 Diagram of research design

The research questions were explored through a series of three distinct, yet related, projects. In accordance with the principles of reflective practice, the objectives and structure of the second and third projects were devised in relation to the findings of the preceding projects. The third project, in particular, underwent significant revision during its conduct in order to generate appropriate data addressing the research questions.

The overall aim of the three projects was to identify and trial methods and tools for understanding, describing, representing, experiencing and generating movement in the design of movement-based interaction. Different conceptions of movement are dealt with in each project. A recurring thread of investigation throughout the three projects is the production and use of design representations of human movement. Two notable sources for potential design representations, drawn from other disciplines concerned with human movement and interaction analysis, were repeatedly trialled in each of the three projects as part of this investigation—Laban movement analysis and its companion movement notation system, Labanotation (see section 3.4) and the analytic framework of Suchman (1987, 2007) (see section 2.3). Labanotation was selected because it is the movement notation that has had the furthest reach into other disciplines, including anthropology, HCI and computer vision. It is also the only notation to include the dynamic, qualitative aspects of movement.

The research methodology is also characterised by a phenomenologically-inspired approach to research, where knowledge and theories are grounded in lived experience. The phenomena of interest are the actions and movements of people for potential interaction in interactive, immersive spaces. Research methods aimed at accessing various aspects of these phenomena have been utilised across the three projects. Ethnographically-inspired methods of interviews, passive/participant observation, videotaping and video analysis have been employed to access first-person, experiential understandings of people's movement and activity in different contexts and situations. Research methods drawn from user-centred and participatory design traditions have been utilised including collaborative design sessions with participants, videotaping and video analysis, enactment and the construction and trialling of

Project / Research Method	Eyetoy	Bystander	Falling into Dance
Interview	✔	✔	✔
Observation	✔	✔	✔
Videotaping activity	✔	✔	✔
Video analysis	✔	✔	✔
Construct/trial design method/tool/probe	✔	✔	✔
Enactment	✔	✔	✔
Collaborative design session		✔	✔

Figure 4.2 Summary of research methods used in each project

design methods/tools in real-world projects or constructed design situations. A summary of the research methods employed in each project is presented in Figure 4.2.

4.1 Issues of methodological validity

For this thesis, the question of methodological validity arose with regards to the design representations produced as part of the research. What was an adequate test of validation for a design representation?

The validation under question is not the same kind of validation usually associated with scientifically controlled experiments, where objectivity and repeatability are the criteria for verification of theory and facts (Crotty, 1998). I am drawing instead, on the criterion of 'workability' as defined by the pragmatic philosophers, Rosenthal and Bourgeois (1977). The test of truth for a pragmatist is workability, not coherence—in simple terms, does it stand up to the test of lived experience (or practice). A philosophic understanding or theory may have internal coherence but if it cannot be verified through actual lived experience, then it is not deemed workable and thus is rejected. In the case of design research, workability can be offered as a criterion for

the validity of design artefacts, including representations of movement. This validity however, is provisional upon the particular design situation.

Validation of design representations (or other design artefacts) is defined for the purposes of this thesis as 'validation through continued use and through applicability to new design situations'. An artefact is deemed valid if, through its use, understandings of the design situation are clarified, elaborated, refined or reconfigured. This validation must be done anew for each specific design situation, as the particularities of that situation will determine the specific criteria for validation. Continued validation in different design situations could eventually make such a representation part of a designer's normal toolkit.

In this research, the design representations of movement produced have two key characteristics. Firstly, they will retain recognisable elements of the lived experience and embodied practice of movement from which they were generated so that they provide adequate means of re-enacting and re-generating the process and quality of movement in order to experience it again. Secondly, they are produced from the perspective of being able to think through possible translations or mappings from the execution of movement by people to the detection and interpretation of those movements by a computer system relying on video-based motion-sensing technology for input of such movements. That is, the representations need to map between people's movements and representations of those movements that a computer could recognise. Not all the representations of movement will have both characteristics, but across the set of representations these two characteristics will hold.

Each project is described in the following sections in terms of its objectives, activities and the research methods employed. Detailed descriptions of the activities and results of each project are provided in the chapters to follow.

4.2 Project I—Eyetoy

The first project consisted of an *analysis* of an existing movement-based interactive product, Sony Playstation2© Eyetoy™, to examine the movements of players in interaction with the Eyetoy games. Eyetoy is an example of a simple form of interactive space composed of a single projected display screen and a motion-sensing input camera. The player stands in front of the screen and uses body movements to interact with the game. The conception of movement in this system is that physical actions and gestures of the player map to physical actions in the game. It was used as a prototype of future systems that are based on human movement and computer vision. This project served as a preliminary exploration of some existing tools that could be adopted or adapted for understanding, analysing, describing and representing human movement treated as input to interactive, immersive spaces. The first tool is the Laban system of movement analysis (LMA) and its companion notation system, Labanotation. The second tool is Suchman's (1987) analytic framework for analysing the interaction between humans and machine.

4.2.1 Research methods

A table of the research methods employed in this project is given in Figure 4.3. This project was undertaken in conjunction with a fellow doctoral student, Astrid T. Larssen and my supervisor, Toni Robertson. Collection of empirical data of eight participants playing the Eyetoy games took place in a controlled laboratory setting. Each participant's game-play was filmed on digital videotape for later analysis. Observations and note taking were made during the session, to be correlated later with the video data analysis. Analysis of video data involved repeated viewings to determine the movements of the players in interaction with the game technology.

Suchman and Trigg (1991) highlight one of the primary advantages of working with video recordings in that it provides a "powerful corrective to our tendency to see in a scene what we expect to see". Video data also facilitates the collaborative interpretation of the material on the video tape

Research Method	Description
Interview	Interviews with participants post gameplay about their experience of playing. Questionnaire with usability related questions.
Observation	Observation and note-taking of participant's gameplay.
Videotaping activity	Video recordings of participants' gameplay from two angles.
Video analysis	Broad sweep of video data to identify basic set of actions and movements for participants.
	Detailed movement analysis and transcription using Laban movement analysis and Labanotation.
	Analysis of human-machine interaction using Suchman's analytic framework.
Construct/ trial design method/tool/probe	Trial of Suchman's analytic framework for analysing movement as input for interaction with machine.
Enactment	Re-enactment of players' movements to gain bodily understanding of movements used in gameplay and skill in using the Laban system of movement analysis.

Figure 4.3 Table of research methods for the Eyetoy project describing the instantiation of each method

by a group of researchers, designers and work practitioners who can bring multiple perspectives to the analysis. Repeated viewings are necessary to clarify and refine the joint understandings elicited from the video material.

We did not transcribe the entire video footage, instead focusing on samples of movement phrases that illustrated the participant's characteristic movement styles, in line with the method of selective transcription for Interaction Analysis described by Jordan and Henderson (1995).

> there is no ideal or complete transcript according to any abstract standard. Rather, the question must be: How adequate is this transcription for purposes of the analysis to be performed? (Jordan and Henderson, 1995, p.10)

Transcription of selected movements was done using Laban movement analysis and Labanotation to gain a more informed understanding of the movements used in interaction and to trial the applicability and usefulness of the Laban system to movement-based interaction design. This analysis required the researchers to acquire understandings of the movement analysis system

through performing and analysing the movements with their own bodies, as well as honing visual observation skills.

The players' actions and movements were further analysed using Suchman's (1987) analytic framework for interaction analysis of human-machine interaction. This enabled the exploration of the relationships between bodily actions and the corresponding responses from technology from the perspective provided by this particular framework. A more detailed account of the process is provided in Chapter 5.

4.3 Project II—Bystander

This project provided a case study of the design of *Bystander*, an interactive, immersive environment built on motion-sensing technology, from conception through to production. *Bystander* is a form of interactive, immersive environment that presents complex data through visual imagery, text and sound and utilises human presence and movement as input. It was part of an Australian Research Council-Linkage grant[1] and involved a design and development process with a multi-disciplinary team of artists, designers and programmers over a two year period.

The conception of movement in this system is one where the patterns of motion and stillness of the visitors are interpreted as indicative of the level of audience engagement with the interactive artwork. Increased motion and physical activity is taken as a gauge of less attentive audience engagement. A quiet and physically still composure is interpreted as a highly attentive audience engagement. As we will see during the development of this project, this conception of movement is problematic for interactive, immersive artworks built on motion-sensing technologies.

The research work was concerned with the extension of traditional human-centred design approaches, methods, tools and techniques to this particular

Research Method	Description
Interview	Interviews with participants post-enactment to discover their understanding and experience of the system and their experience of using personas and scenarios.
Observation	Participant observation in design process.
Videotaping activity	Video recordings of scenario enactments in prototype environment. Video recordings of interviews post-enactment. Video recordings of visitors to final exhibited work.
Video analysis	Analysis of video data to observe activity and movements of participant users for reflection and refinement of design tools. Analysis of video data to extract patterns of movement of visitors to final exhibited work.
Construct/ trial design method/tool/probe	Construction and refinement of moving personas, movement-oriented scenarios, movement schemas in Labanotation, user activity script for use in iterative design process. Adaptation of Suchman's analytic framework as a design tool for exploring the human-machine interactivity.
Enactment	Scenario enactment following user activity script in prototype environment.
Collaborative design session	Regular meetings with entire design team to exchanges ideas and present various design artefacts by different stakeholders.

Figure 4.4 Table of research methods for the Bystander project describing the instantiation of each method

genre of movement-based interactive systems. The emphasis for this thesis was on constructing design representations to explicitly address moving bodies, embedded in social interaction and the subsequent use of these representations for design reflection-in-action through physical immersion and enactment of movement in the prototype environment.

4.3.1 Research methods

My role was as a researcher and participant in the design process. I was part of the team of three technology designers investigating the use of human-centred design methods and tools in the creation of an interactive, immersive, artistic work. We worked on the project with the two artists/authors of the work and other professionals skilled in programming, exhibit design, digital sound composition and graphic design. A table of the research methods employed in this project is given in Figure 4.4. The development of the system

involved iterative cycles of design activities with the creation, use and refine-
ment of design representations of moving bodies. In particular, this involved
the construction and refinement of moving personas, movement-oriented sce-
narios, movement schemas in Labanotation, the user activity script and the
further adaptation of Suchman's (1987) analytic framework as a design tool
for exploring the human-machine interactivity. Scenario enactment following
the user activity script was conducted twice in the prototype environment to
test the system with users and for the designers to experience the potentials
for interaction offered by the system. Interviews were conducted with partic-
ipants of the user testing post-enactment to discover their understanding and
experience of the system as well as their experience of using personas and sce-
narios to guide the enactment. The interviews and the scenario enactments
were videotaped for later analysis and feedback into the design process. The
design representations of moving bodies and the results of the user testing
were exchanged with the design team at regular meetings. The activity of
actual visitors to the exhibited work was recorded on digital videotape for
later analysis of the patterns of audience behaviour and movement. A more
detailed account of the process is provided in Chapter 6.

4.4   Project III—Falling into Dance

The primary aim of the third project was to validate and extend the find-
ings of the first two projects. A range of motivations existed for the kind
of research activities undertaken in the third project. Firstly, to continue
and extend the work done in the second project, Bystander, on construct-
ing forms of representation for design that deal explicitly with the moving
body or bodies. Secondly, to see how the methods and tools already used in
the previous two projects can be applied to this new design situation and,
if necessary, extend or augment the methods and tools. Thirdly, to extend
the range and kinds of movement to be sensed, from everyday movement (in
Bystander) and limited range of arm gestures (in Eyetoy) to more complex,
heightened and choreographed forms of movement. More complex forms of
movement were examined, such as the action of falling and choreographed

phrases of movement. The action of falling is considered to be a complex movement that required significant investigation into its performance and a subject's experience of that performance, prior to designing for such an action. Falling is a movement that we all know in some way but do not necessarily practice. As such, it lends itself to making strange. The action of falling takes the body on a trajectory through a volume of space that is often traversed in all three planes simultaneously. The body assumes different postural positions through the trajectory, including standing, off-centre, contracted, spreading and extending and lying on the ground. This range of body postures in motion presents a complex form of input for a computer vision-based input device. Similarly, choreographed phrases of movement present complex forms of input if they are to be recognised as such.

I chose to work with trained dancers and physical performers for their expertise in using the moving body as a design material (Schön, 1987). I saw the practices of dance, movement and choreography as a rich source of potential methods and tools that could be reapplied in this field of movement-based interaction design. A series of studies was undertaken to trial and identify a range of methods and tools for working with the moving body, which start from the experience of the moving body. The first study was of skilled movers in the act of falling. The second study explored ways to choreograph movement.

The primary aim of this third project was achieved through a *constructed design situation*, using a hypothetical, future system as a vehicle for further exploring how movement could be understood, described, represented, experienced and enacted in the design of such movement-based interactive systems. Unlike the second project, Bystander, there was no readily available design project in which to situate this work. The creation of a constructed design situation enabled prolonged attention to, and visibility of, the design artefacts and their transformations throughout the project. It also meant that the design situation itself was open to modification and reshaping according to how well it was serving the aim of the project. In actuality, this is what happened. This third project was interlaced with periods of critical reflection on the unfolding research work as it was conducted. The activities
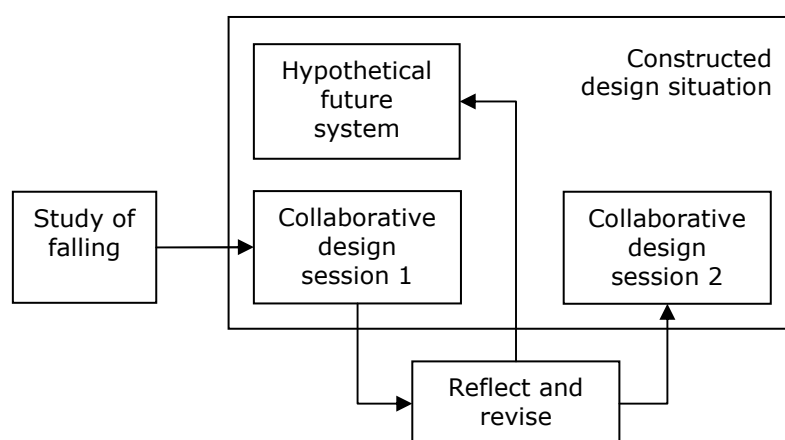
Figure 4.5 Diagram showing revision of Falling into Dance project

in the project underwent revision and were reformulated to better serve the primary aim of the project, as summarised in Figure 4.5 and described below.

The original vision for the constructed design situation of the third project revolved around the exploratory design of an interactive space that sensed the action of falling. The first activity involved a movement study of the act of falling with eight participants. The outcomes of this activity were an understanding and description of the act of falling as experienced by skilled movers. This data was then used as material in the following series of collaborative design activities undertaken with skilled movers. It is the second of these collaborative design activities that underwent significant revision after critically reflecting on how well the first collaborative design activity contributed to the aim of the project and the research questions. Along with a revision of the second collaborative design activity was a substantial change to the hypothetical future system. The research process governing the design and conduct of the second collaborative design activity was instrumental in generating new methods and tools that addressed the research questions of the thesis.

Research Method	Description
Interview	Interviews and physical demonstrations with participants to understand the act of falling by skilled movers.
Observation	Observation of physical demonstrations. Participant observation in study of choreographing movements.
Videotaping activity	Video recordings of physical demonstrations. Video recordings of collaborative design sessions.
Video analysis	Analysis of video data to generate a range of descriptions and representations of the falling body. Analysis of video data to generate a range of descriptions and representations of the choreographed moving body. Analysis of video data to identify methods for generating and devising movement from the practices of dance and movement improvisation practitioners.
Construct/ trial design method/tool/probe	Trialling forms of representing movement ideas and choreography and corresponding interactive treatment. Production of inspirational resource kit to inspire and constrain movement ideas and choreography contributed by the participants.
Enactment	Enactment of choreographed movements during collaborative design sessions to acquire a bodily understanding of the movements.
Collaborative design session	Working with dancers and movement improvisation practitioners on generating and choreographing movement for use in an interactive, immersive space.

Figure 4.6 Table of research methods for the Falling Into Dance project describing the instantiation of each method

4.4.1   Research methods

A table of the research methods employed in this project is given in Figure 4.6. In the first study, interviews and physical demonstrations were conducted with eight participants trained in dance and physical performance. These sessions were filmed on digital videotape for later analysis. As the researcher, I acquired first-hand experiential data on the act of falling through learning how to fall under the instruction of some of the participants. Data analysis of video footage was performed to determine the nature of the experience and process of the act of falling across the eight participants, from the first-person perspective of the participants. A range of descriptions and representations of the falling was also extracted from the video data for potential use in the design process.

In the second study, collaborative design sessions (or workshops) were conducted with dance and movement improvisation practitioners to find ways of generating and choreographing movement for use in movement-based interaction design. I took part as a participant observer in these sessions in order to acquire a bodily understanding of the movement ideas and choreography. A set of resources for inspiring and constraining the movements choreographed for interaction and a range of design representations of movement and corresponding interactive treatments for use in movement-based interaction design were trialled with the participants. These representations were created during, and refined after, the design sessions. The design sessions were filmed on digital videotape for later analysis. Data analysis of the design sessions was performed to identify and describe methods for generating and choreographing movements from the practices of dance and movement improvisation practitioners. A range of descriptions and representations of the choreographed moving body was also extracted from the video data for potential use in the design process.

In both studies, elements of Laban movement analysis and Labanotation were used to analyse and represent aspects of human movement that could be relevant to the design of interactive, immersive spaces built on video-based, motion-sensing technologies. In particular, Laban Effort-Shape analysis and Labanotation floor plans were utilised.

4.5   Summary—Research Methodology

Each of the three projects explored and contributed to understandings of movement and to the repertoire of methods and tools for designing movement-based interaction from a starting point in the experiential, moving body. The findings from all three projects are brought together in the major contribution to the thesis, the design methodology of Moving and Making Strange. The original genesis of the methodology resulted from the outcomes of the third project. The final form of the methodology is a synthesis of the outcomes of all three projects and is described in Chapter 9.